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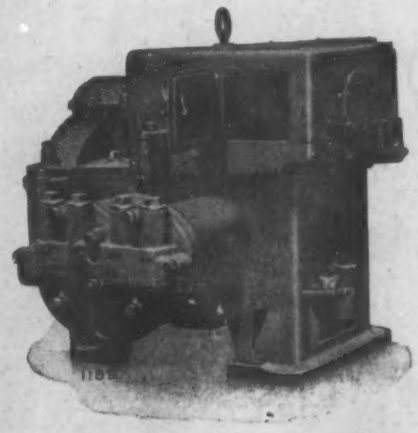

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				Full Load	¾ Load	½ Load	¼ Load	
22	4.4	16	2.74	93.	93.1	92.7	87.1	500
26	3.33	22	2.72	94.	94.1	92.9	88.2	750
30	3.00	27	2.70	94.6	94.50	93.19	89.86	1000
37	2.42	34	2.46	95.4	95.41	94.28	90.50	1500
44	2.20	46	2.43	95.70	95.79	94.57	91.00	2000
48	1.92	55	2.37	96.00	96.12	95.41	92.53	2500
49	1.63	60	2.30	96.40	96.54	95.93	93.50	3000
55	1.37	82	2.27	96.67	96.82	96.31	94.40	4000
61	1.22	100	2.15	96.83	97.12	96.70	95.00	5000
87	1.16	145	1.98	97.00	97.32	97.02	95.40	7500
105	1.05	177	1.83	97.25	97.48	97.21	95.52	10000
122	.98	202	1.76	97.40	97.70	97.39	95.95	12500
134	.90	252	1.64	97.50	97.74	97.42	96.11	15000
163	.80	320	1.55	97.64	97.89	97.79	96.46	20000
187	.75	380	1.48	97.78	98.03	97.88	96.76	25000
204	.68	432	1.42	97.92	98.12	97.96	97.01	30000
244	.60	556	1.40	98.04	98.28	98.12	97.29	40000
271	.54	640	1.30	98.21	98.44	98.30	97.57	50000

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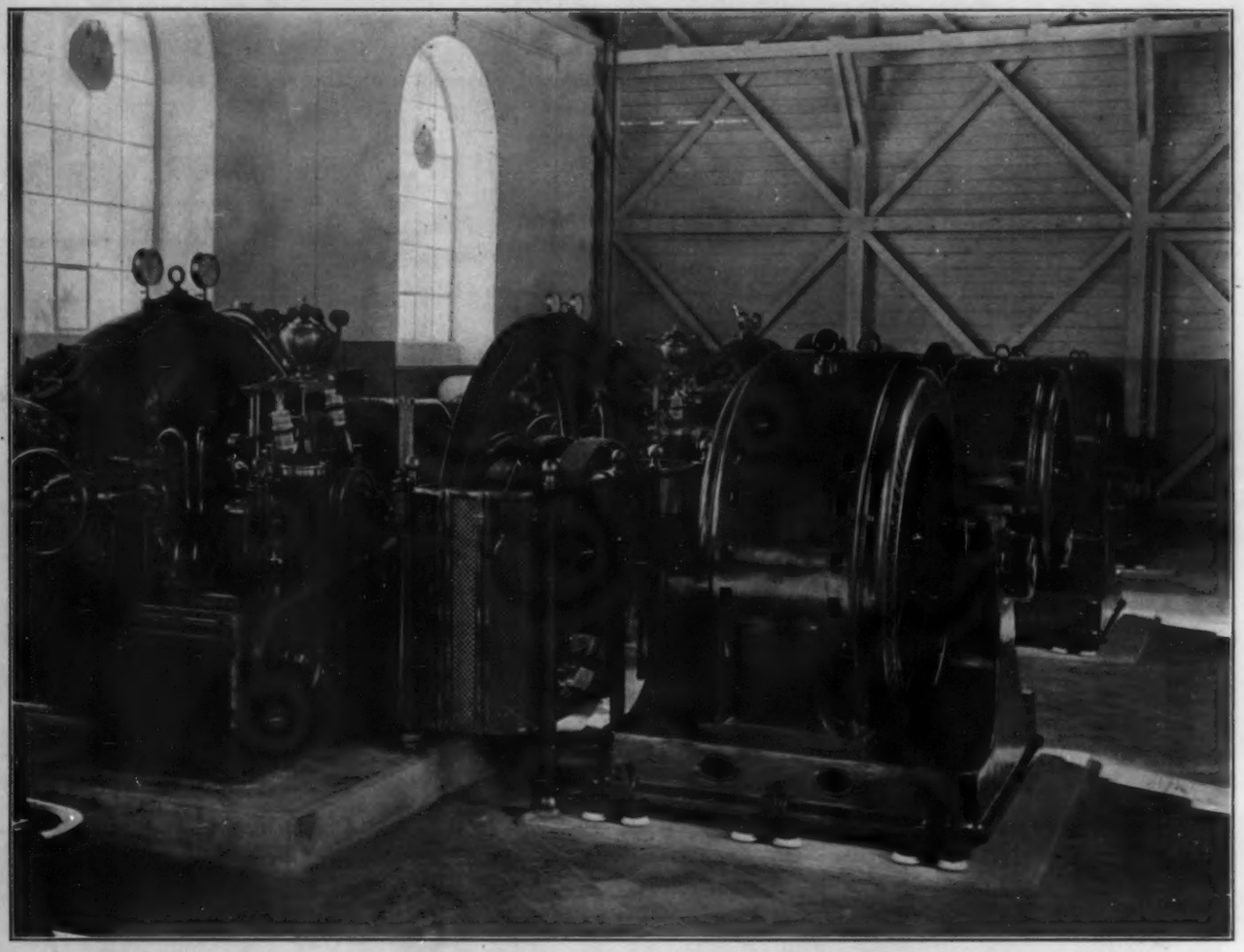
Hydraulic Turbines of Swiss Manufacture.

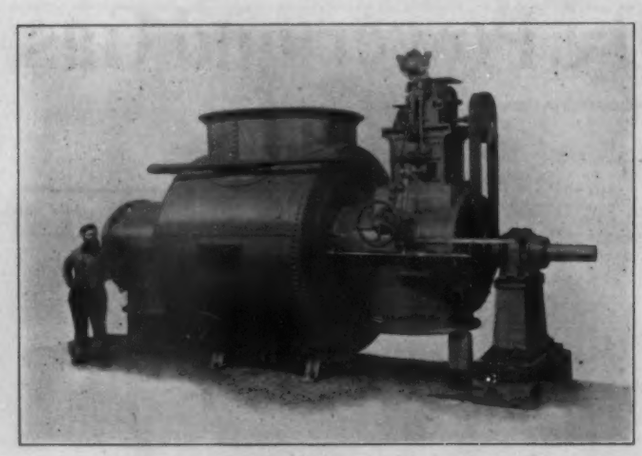
Although French engineers have made some progress in the design of hydraulic turbines, the Swiss have surpassed them in producing machinery of this type of a very high efficiency. As a result the products of their design and manufacture are found in power plants and pumping stations all over the world.



FIER HYDRO-ELECTRIC PLANT HAUTE SAVOIE, FRANCE.

At the Usine de Sant-Mortier, near Jura, France, nearly 3,000 horsepower are developed by four Swiss turbines, each having a capacity of from 700 to 750 horsepower. These operate under a head of 65 feet at 250 revolutions per minute, driving the alternators through elastic insulating couplings of the Rafford system. A feature of the exciters is that they are mounted on the same shafts as the alternators, but outside of the main bearings. In addition to the four units already described, a turbine of the same type but capable of developing 1,250 horsepower is also installed at this plant. Its speed is 214 revolutions per minute.

The station is located near the junction of the Ain and Bienne Rivers which of themselves carry an insufficient quantity of water to generate the required horsepower. It was therefore necessary to construct a canal from Lake Chalain,



SWISS TURBINE AT SAUT MORTIER HYDRO-ELECTRIC PLANT IN FRANCE.

some distance away. By this means the quantity of water available was increased by 565 cubic feet per second.

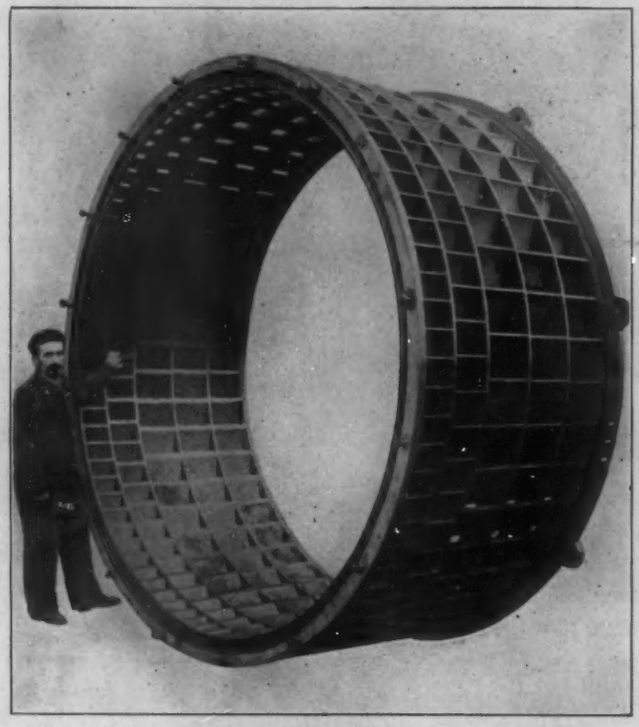
The turbines at the Jura plant are all of the horizontal type. A vertical shaft turbine has been installed in a hydro-electric plant at Meurthe et Moselle to operate under a very low head of from 4.9 to 6.2 feet. Its speed is only 32 revolutions per minute and its total capacity is 165 horsepower with a discharge of from 210 to 350 cubic feet per second.

The water wheel is 9.2 feet in diameter, and on its periphery are arranged five rings of buckets. A bevel gear-wheel of about the same diameter as the water wheel is fastened to the vertical shaft and drives a pinion mounted on a horizontal shaft, which supports a fly-wheel more than 13 feet in diameter and rests in three large bearings. The water is conducted to the wheel through a concrete chamber and is led onto the buckets by guides built at the sides.

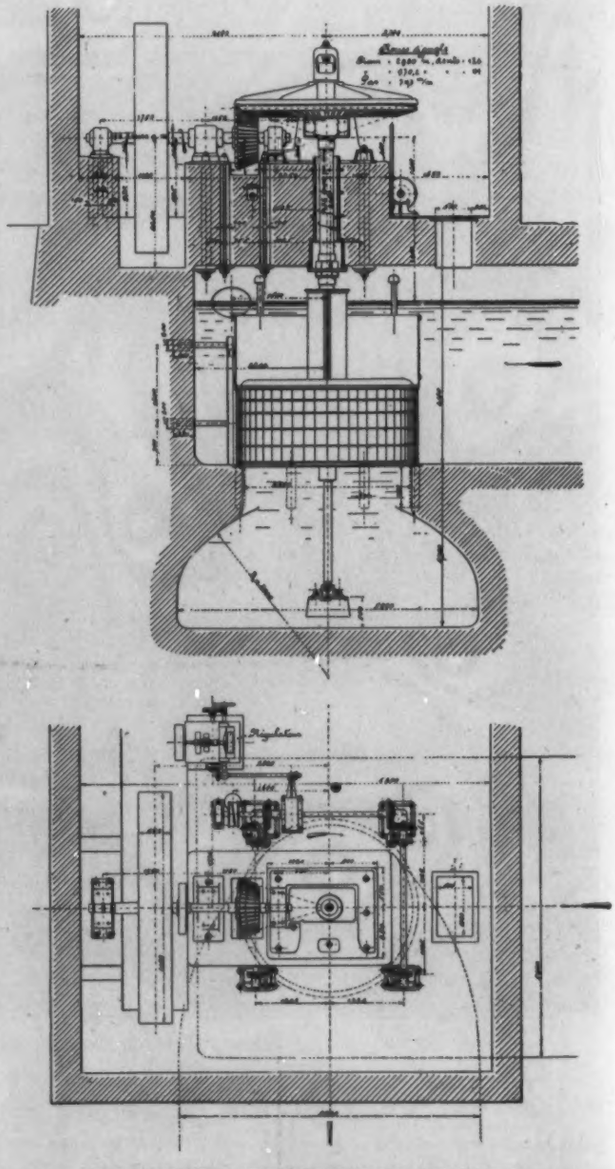
At Montiers, Savoie, also in France, four Swiss turbines are employed for generating electrical energy to be transmitted to the City of Lyons. Each of these is capable of developing 1,570 horsepower under a head of 213 feet, and drives an alternator by direct connection at a speed of 300 revolutions per minute.

Turbines of a similar type to the above but of much smaller capacity, are employed in the Usine Hydro-Electrique de Verein, in Spain. These have a normal output of 120 horsepower and operate at a speed of 600 revolutions per minute.

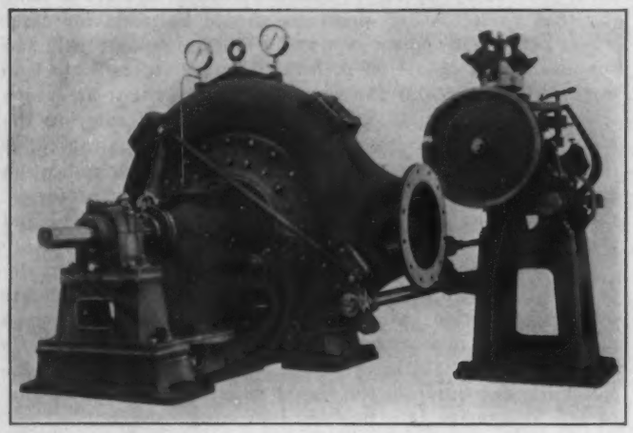
The regulation is accomplished by a ball governor, and the power required to operate the gate valve is taken from the main turbine shaft through a belt transmission. At normal load working under a head of 146 feet, each turbine takes about 9.5 cubic feet of water per second, which enters at the side and is discharged at the end.



STATOR AND GUIDES OF LOW-PRESSURE, LOW-SPEED SWISS TURBINE.



LOW-SPEED, LOW-PRESSURE TURBINE.



SWISS TURBINE AT THE VERIN HYDRO-ELECTRIC PLANT IN SPAIN.

At the Installation Hydro-Electrique du Fier, there are in operation three hydraulic turbo-generator sets, each of which consists of a turbine and alternator connected by a flexible coupling, with a fly-wheel mounted between them. The normal speed is 430 revolutions per minute and the capacity of each turbine is 375 horsepower for a head of 60.5 feet. The exciting current for the alternator fields is supplied by a four-pole dynamo driven at a speed of 800 revolutions per minute by direct connection to a 20-horsepower water turbine. Servo-motors are employed as regulators, and give excellent results.

TRAIN MOVEMENT.

By Elbert G. Allen.*

Choice of Motors.—The general type and size of motor to be used in a given service is a fairly well-settled fact. It is, of course, necessary for economic reasons to use some standard motor of a reputable manufacture. The various manufacturers have well-developed types of motors suitable for use under the various conditions of service. Knowing, then, the approximate conditions under which the equipment will operate, such as weight, schedule, speed, grades, and number of stops, it is easy to narrow down the choice of equipment between two or three sizes by comparison with the satisfactory performance of other roads and the general statements of the manufacturers. The definite and careful selection between these two or three motors is a matter for considerable skill in the analysis of the requirements of the case. For interurban roads, the performance of the motors can be very accurately foretold. The conditions of stops and schedule speeds are matters for pre-determination. The schedule speeds are to a certain extent dependent on the final selection of the equipment itself, but in general the selection of the latter is subject to the requirements of the former. Knowing the conditions it is only a matter of calculation to lay out speed-time and speed-distance curves for the entire run for any equipment by the use of motor characteristic curves furnished by manufacturers. From the curves can be determined the proper gear ratio for each equipment and those which cannot make the necessary schedule can be eliminated from consideration. The question then remains whether the equipment selected will give the service without overheating. With the speed-time curves worked out, the manufacturers stand ready to guarantee apparatus to give the proper performance without overheating.

It is frequently permissible to omit the working out of speed-time curves for the entire run but to select some typical parts which are repeated several times during the run and base calculations on these. With an interurban road running through a level country where stops are about equidistant, a single run may frequently be selected which is typical of the entire run, and is merely repeated between each stop. At other times it becomes necessary to select several typical runs—for example, one on a level, one on an average grade, etc.

For convenience in comparison it is customary to rate a railway motor by the horsepower output which it can maintain for an hour with a maximum rise in temperature of seventy-five degrees Centigrade when tested in the shop. Such a rating gives little information regarding the amount of output which the motor could safely maintain under service conditions, and there is no connection between this rating and any information which can be obtained by analyzing the speed-time curves for a run. In order that one may determine the effect of any run on the temperature of the motor it is necessary to have either definite experimental knowledge of the heating of the motor under a variety of operating conditions similar to the required conditions, or a knowledge of the characteristics of the motor, such as the copper and iron losses for all conditions of voltage and output.

By means of exhaustive tests in which a motor is put through a certain definite cycle of operations repeatedly until its temperature becomes steady, it is possible to tabulate for any motor the temperature rise which it will sustain if required to propel any given weight at a given schedule speed making a given number of stops per mile. If this data is available it is only necessary to reduce any given operation to a repetition of typical runs and by reference to the tables, to find the temperature rise which the motor sustains if repeatedly put through this cycle of operation. This method of judging of a motor's fitness for the work to be imposed upon it has the advantage that it is based on actual tests made under service conditions. It is a method, however, which may be employed only after very exhaustive tests, and is difficult of application where no very typical run can be selected. Moreover, it gives no good means for direct comparison of different equipments and leaves a purchaser to rely almost solely on the advice and guarantee of the manufacturer.

The electrical losses in a motor consist of the copper and iron losses. The copper losses are proportional to the square of the current input. The iron losses are variable with the impressed voltage and to a certain extent with the current. It would appear that if a motor were passed through any cycle of operation the heating could be fairly well reproduced by subjecting the motor to a stand test with the same average voltage at the terminals and the square root of mean square value of current input. This being true, a very simple method of comparing the service capacity of motors consists in subjecting them to stand tests under these conditions and observing the rise in temperature. If, during the run, a motor is to be subjected to an excessive rate of input for a short time, as, for example, in climbing a steep hill, the rise in temperature during this time might exceed the average rise. It is consequently necessary to know also the length of time necessary for a motor to reach a dangerous temperature at any rate of input above the normal rate. By stand tests the safe square root of mean square current for continuous running may be determined and also the safe length of time for which higher rates of input may be maintained. With this data it is easy to compare different motors and to determine if a motor is suitable for the work in hand.

This method has been objected to on the score that the stand test does not reproduce exactly the conditions of ventilation and distribution of losses of the actual run.

*This is the second of the series of lectures by Mr. Allen before the Electrical Engineering students of The University of Washington.

For ordinary work either the manufacturers' data based on experimental runs or on stand tests with equivalent current is reliable and adequate. Final decision in any case depends upon the manufatcurers' guarantee.

For city and suburban service, it is, of course, impossible to work out speed-time curves covering the entire performance of the car. No two runs will be alike on account of the varying number and location of stops and variations caused by external conditions, such as blockades, etc. It is surprising, however, on comparing the runs over a given route, day in and day out, to see how nearly alike they all are as regards their general features of schedule speed, stops per mile, per cent. of drifting, etc. As a result of this it is almost always possible in such service to select a single cycle of acceleration, coasting, braking and stop which shall constitute a run typical of the entire day's performance. From such a typical run data may be obtained which will enable an equipment to be selected by the methods used in interurban work.

Four-motor vs. Two-motor Equipments.—The advisability of using four-motor equipments for all but very light traffic or in places where grades are light and weather conditions good, is generally conceded. The change from the use of two to four-motor equipments has been brought about by the increase in car weights, speed and the necessity for extremely rapid accelerations. On account of the high-schedule speeds desired with frequent stops, low-gear ratios and rapid accelerations have become a necessity and these demand a high tractive effort and a relatively large motor capacity. Four-motor equipments have become a necessity in order to gain the necessary motor capacity without the use of motors of excessive size, and in order to increase the maximum tractive effort by making all the weight available on driving wheels. The entire weight on drivers is desirable both to obtain the desired acceleration and hill-climbing ability under normal conditions, but still more to obtain the best possible results when the rails are in poor condition on account of sleet, snow, etc.

As a matter of efficiency the two-motor equipment, other conditons being equal, is the more efficient in accordance with the general rule that subdivision of units decreases the aggregate efficiency. There is, however, less heating with four motors of equal combined power as the radiating surface is increased in greater proportion than the losses. The actual power consumption in a four-motor equipment is increased only by the slightly increased loss in efficiency. The belief that a four-motor equipment demands more power is due to the fact that in nearly every case the four-motor equipment is called upon for more work by hauling heavier cars or by actually making better time.

The cost of maintenance of a four-motor equipment may be expected to be less than that with two motors on account of the decreased heating and the smaller current to be handled by the commutator. Other advantages are the ease in handling the smaller motors, their greater clearance when placed under a car, the decreased wear on gears, axle bearings, trucks and wheels due to the division of strain and decreased slippage.

Block Signals.—On account of the necessity of using single track and turn-outs for electric lines many forms of block signals have been devised in order that two cars may not attempt to use a single track section in opposite directions simultaneously. Such block signals may be either manually operated or automatic in their action. If automatic they may be operated by the passage of the trolley wheel on some circuit-closing device, by some form of rail contact, or by the electrical short circuiting of the two rails by the wheels and axles of the cars.

It is frequently desirable that signals shall permit of the entrance of more than one car on a block if passing in the same direction in order to permit of "double heading" on special occasions or to allow two different lines to use a common section of track. Such signals should be cleared only when as many cars have left the blocks as have entered it. In a perfect signal provision should be made for cases where cars enter opposite ends of a block simultaneously and the mechanism should be such that if a car enters a block in error—for example, if the signal be set against it at a time when it be impossible to stop the car before entering the block, the act of leaving the block to wait until it can rightfully enter should restore the signals to a proper indication and leave the car rightfully in the block properly protected. Cars should be able to leave a block from either end and leave the signals indicating properly.

For the use of steam roads, block signals have been developed to a high state of perfection wherein the signals are built in a position indicating safety or a clean block by an electric circuit involving both rails of the track. The wheels and axles of a train in the block shirt-circuiting these rails, shunt the current from the signal relay and cause the signal to fall by gravity to a position indicating danger.

In steam-road practice, the various blocks have been separated by insulated rail joins. This practice needs modification in applying it to electric roads on account of the necessity for a continuous rail circuit for the return-motor current. A very successful system has been developed by using alternating current for the signals. The insulated rail joints are bridged by inductive bonds which have low ohmic resistance allowing the power current to pass freely, but high resistance effectively separating the blocks so far as the alternating signal current is concerned.

INDUSTRIAL PROGRESS IN ITALY.

It is stated that not only the leading Italian shipyards but also the locomotive and rolling stock factories are full up with work. The general briskness in the industrial world is, however, most remarkable in the south of Italy. Outside the cities of Naples and Palermo new industrial quarters are developing. The Naples Provincial Parliament has decided to construct a hydro-electric plant on the Volturno, at a cost of £400,000, whilst at Pónte della Serra (close to Padua) the Eismon River is to be used to generate 20,000 horsepower for use in various industrial establishments. Apart from such typical private enterprises it is notable that the revenue of the State shows a large and steady increase, and that considerable sums are now available for disbursement in various industrial and social improvements. Special attention is being paid to the needs of Italian railways, and the Government is now seeking authority to issue new 3½ per cent bonds, repayable in forty years, for £24,400,000. As an issue of £12,000,000 has already been granted for railway purposes, this would give a total sum of £36,400,000 to be spent from 1907 to 1911 in improving Italian railway services.

VARIABLE SPEED TURBINE ENGINE.

A turbine has been patented in England which, by means of two sets of steam admission ports, into either of which steam may be admitted at will, it is claimed will give two different speeds of operation at the same efficiency. For the higher speed the steam is conducted from one set of ports through expanding nozzles to the rotor, where it encounters two sets of moving blades and one set of fixed blades, passing thence to the exhaust. For the lower speed, the steam takes the same path through the blades as before, and is then led from the second set of moving blades into a group of blades consisting of two fixed and two moving sets. This arrangement gives a speed about half that due to the other, the reason being doubtless that, the expansion being carried through a longer stage, the drop in pressure at each set of blades is but half what it was before, with consequent proportional speed factor.—"Iron Age."

THE TESTING OF COAL.

By A. Bement.

The purchase of coal under specification stipulating its composition, and the analysis of the fuel delivered under such specification, has now become an important feature of the coal business, and while the practice is of comparatively recent origin in this general locality, experience has demonstrated that there are certain features of specifications and analytical methods which may be corrected and improved. This applies particularly to the business transactions between the dealer who sells the coal and the purchaser who burns it. Another phase of the problem concerns the work being done at the coal-testing plants of the United States Geographical Survey at St. Louis, the Illinois Geological Survey and the Engineering Experiment Station, of the University of Illinois. The work of these institutions may be considered as that of research, to distinguish it from the inspection service.

It is the principal object of this paper to emphasize the necessity for improving the practice governing specifications and inspection, and also to suggest certain lines along which the research work should proceed, and it is fuel coal from the eastern interior coal basin that is more particularly considered.

The improvements and corrections which concern terms of specifications, and the inspection service, require that determinations of the following be abandoned:

Moisture,
Volatile matter,
Fixed carbon,
Sulphur,
Evaporative power of the coal.

Every essential requirement of the purchaser may be fulfilled by confining specifications and tests to the three following characteristics; in fact, these three features alone will insure greater protection to the purchaser than obtainable under present general practice:

Per cent. of ash in the dry coal,
Size of the coal,
Heating power of the pure coal.

The latter, according to prevailing practice, would preferably, of course, be expressed in British thermal units.

The reasons for the above recommendations are given under the following captions:

Moisture.

Moisture is a great and uncertain variable. It not only differs in various coal seams as the coal lies in the ground, but is affected in fuel as received in shipment, by conditions of weather, temperature and time the coal may be in transit. It is approximately correct, however, to say that each coal seam has a characteristic moisture content of its own, which is uniform over at least very considerabde areas, but the after influences above mentioned change it, so that there is no assurance of what it may be except under specially defined conditions.

Therefore, the producer or coal dealer can exercise no control over moisture, and as ihe prime object of fuel inspection service is to insure that the customer is served to the best ability of the dealer, specifications and tests of moisture in coal delivered can offer no protection to the purchaser. As before mentioned moisture varies in different coal seams; for this reason it might appear that its determination would indicate the seam from which the coal came. This is not true, however, for reasons above mentioned. If tests are expected to identify the seam which produced the coal other means must necessarily be employed.

However, in coal inspection service, moisture has been found to be very high in cases where delivery is by wagon, which, owing to lack of sufficient explanation of phenomena at the time, may have led to the opinion that the dealer wetted the coal for the purpose of increasing its weight at the time of loading. If this is the practice, it necessarily complicates the problem, but the writer has had cause to visit every coal yard in Chicago, and never observed any wetting of coal or any appliances for such purpose. It would be a difficult and expensive matter to wet fuel as loaded, and require water pipes located along team tracks, which in some cases extend for several hundred feet, and with the finer sizes of coal it would necessitate a man stationed at each wagon to supply water as fast as the coal was loaded, otherwise it would be impossible to add any great amount, because simply flooding the top of a wagonload of screenings, for example, would only insure the upper surface being wetted, as the water would not penetrate the mass. A further study of this matter has made it appear to the author, that this high moisture in wagon-delivered coal is due to the practice of wetting coal while it is being unloaded, very often done for the purpose of allaying dust, and to the water which is commonly added in the fire room for various reasons, both prior to the time of sampling.

This matter of moisture also complicates the problem as far as the inspection service is concerned, because it is impracticable for the inspecting company to have its sampler present when a wagonload of coal arrives, as it would entail an expense which the service could not bear. Also, sampling attempted at the time of unloading could not be properly performed, as the sampler would be unable to gather from a wagon at the sidewalk and prepare a sample as it should be done. Thus it appears, that the determination of moisture, even in wagon-delivered coal, serves no useful purpose. With fuel received in cars, there could, of course, be no opportunity for adding water.

Volatile Matter.

No fuel coal of this locality is purchased for the purpose of making gas or for use in by-product recovery plants, therefore tests for this constituent are unnecessary, unless there be a great difference in the coal. "Volatile matter" is not very well understood. The best conclusion is that coal is a complicated hydrocarbon which breaks down in distillation into various fractions, depending upon temperature and duration of heating period, and that the difference in coal of this basin is not greater than that due to the varying effect produced by the volatilization test itself; or, in other words, the variation may be caused by the test rather than by the composition of the coal. Thus the volatile matter test is not sufficiently accurate to be of service in this case. It is, of course, true, that it would distinguish between bituminous, semi-bituminous and anthracite coal, but one may do this merely by inspection without any test whatever.

All coal of this basin is high in "volatile matter"; all will make smoke if burned in sufficiently bad furnaces, and all will make smokeless combustion and good efficiency in good furnaces.

Fixed Carbon.

In coal analysis the disposition is to follow precedent. Coal mining became an important industry in the East long before it did in this locality. Much coal in the Appalachian basin is suited to the manufacture of a high grade of coke, and the amount of residue, or, in other words, the coke obtained under the conditions of the process, is a matter of first importance. This has had the effect of emphasizing the importance of "fixed carbon," so that it has been looked upon in many quarters as of more moment than any other chararteristic of coal, and these ideas, extending to our locality, have to a considerable extent influenced opinion regarding fuel. The same remarks regarding the uncertainty of the determination of volatile matter apply to that of fixed carbon, because the test for the former is the one giving data for the latter. If coke was made from coal of this locality, it would be possible under certain conditions, to make a use-

ful application of the test for fixed carbon; inasmuch, however, as it is not the case, this constituent is only a troublesome and misleading feature of analysis.

Sulphur.

Sulphur has been in a measure treated in the past the same as fixed carbon. In metallurgical work it is of extreme importance, and in this connection has received more attention than with fuel coal. This has given a prominence to the sulphur determination which it would not otherwise possess, and upon the assumption that sulphur is in the form of pyrites or very largely so, the conclusion has been accepted that the amount of sulphur is an indication of the tendency of the ash in the coal to clinker. This is true, however, to only a slight extent; in fact, may not even be considered as a working hypothesis in this coal basin, because some of the seams which are the highest in sulphur produce the least clinkering, therefore conclusions regarding the behavior of the ash in this respect are not justified by the amount of sulphur in the coal.

Evaporative Power.

This is something which should never, under any circumstances, become a feature of specifications or guarantees, for several very important reasons. In general, too many variable factors enter into the problem. For example, boilers differ, some being more efficient than others, absorbing greater or less amounts of heat from the coal for reasons due to their individual superiority or inferiority. Then furnaces differ greatly; in some cases all of the volatile matter may be burned; in others, a large portion be wasted. Again, fire grates differ in like measure, causing varying losses of fuel which falls into the ash pits, and the combination of grate and furnace has an important influence on the excess of air which necessarily enters, and for this latter reason, also, the useful result obtained from the coal is affected to a marked extent. The above refers to the characteristics of the apparatus itself, but at this point another and most serious variable must be considered, that of the personal equation of the fireman or furnace operator; therefore it is apparent that in such a test, one may be unable to discover whether the result is due to the fuel, the peculiarities of the apparatus or its manipulation. In the case of a coal purchaser who does not realize these facts, the result is always attributed to the object in view, which is, in such instance, to determine the value of the coal. If he had wished to discover whether he employed a good fireman or not, the experiment would have been precisely the same, and he would have then considered the result due to manipulation. It is not only the above features which have an important influence, but the character of the load on the plant is a matter of great moment. In a works where the boilers run steadily for twenty-four hours, the result secured, everything being equal, will be much better than in one where the work is necessarily interrupted by stoppages at noontime, shutting down at night, or with peaks of load, as in electric railway service. Any one of the foregoing causes may exercise a greater influence on the evaporative result secured than that due to variation in fuel.

It is not intended in the above to imply that coal-burning experiments are not useful, because there are some things which may be settled as affecting certain plants; for example, fuel high in ash generally costs less per ton than that containing less ash, and it might be a question which would be the most economical to use; or, the matter of the most desirable size of fuel may be in question. These two are the only features which can be settled by burning coal under a boiler, and they should not be made part of a specification or guarantee, but used entirely for the guidance of the fuel user in selecting the best grade.

The behavior of coal under boilers is a problem very little understood, because it is the result of many variable influences, and for this reason it is often felt that the calorimetric test is unreliable, which, however, is not true, because the calorimeter does its work very accurately as far as the coal itself is concerned; its efficient utilization in service is influenced only by the amount and fusibility of the ash associated with it and the size of the pieces of the fuel. This matter has been extensively treated elsewhere. (See Mr. Abbott's paper, presented September 5, 1906.)

It is well in this connection to direct attention to the fact that there is a feeling more or less prevalent, that coal from different localities or seams may possess some undefinable peculiarity in its chemical combination, which causes it to behave differently under a boiler than it would in a calorimeter. Such conclusion is untenable, because the process is identical in each case, that of combination of oxygen with the carbon, hydrogen and sulphur of the coal, and this combination can not be any different under the boiler than in the calorimeter, unless influences due to the peculiarity of the boiler apparatus and its manipulation assert themselves, and it is the disposition as far as the coal is concerned, to blame it for effects which are due to causes other than its chemical composition. It is well in this connection to call attention to the fact that the heating power of the coal proper, or, in other words, the pure coal in Illinois, only ranges from 14,000 as a minimum, to 14,750 British thermal units as a maximum, and that about eighty per cent of the fuel produced ranges between 14,000 and 14,500 British thermal units per pound. Thus the enormous variation found in service under boilers as far as the amount of water evaporated per pound of coal is concerned, is mostly due to the characteristics of the apparatus, its manipulation, and to the size of the coal and the amount of ash associated with it.

Thus it is very clear that specifications or guarantees covering amount of evaporation per pound of fuel or per cent efficiency, are not only useless but troublesome to the purchaser and dealer.

The three approved tests may now be considered, and while in the above classification they are presented in the order of greatest importance, it will be convenient to change their arrangement.

Pure Coal.

For better understanding, it is desirable to consider coal as the chemical combination of certain elements which are principally heat producing. The association of ash and moisture with these result in an aggregation which may be designated as fuel, although generally called coal, which, from this standpoint, however, is not correct, because neither ash nor moisture produces heat. The expression, pure coal, is the equivalent of what has erroneously been called combustible, the pure coal containing all of the combustible matter, and some water of composition and nitrogen which are not combustible, but as these two ingredients are associated chemically with the combustible the ultimate conception of coal is covered by this term, pure coal. Thus in the heating power determination, it is more to the point to base results on the pure coal than on any of the fuel mixtures, illustrated as follows: Let it be assumed that in one case the British thermal units per pound of dry coal is 13,250, and in another 12,450, from which it would appear that the two lots of fuel were different, but if the percentage of ash content in each is known, and the first sample contained seven per cent and the latter twelve per cent, it appears that each sample has a pure British thermal unit of 14,250, or, in other words, that the coal is the same in each, there simply being more ash associated with it in one case than the other. Basing the heating power determination on pure coal has another very important advantage, as it enables one to judge of the accuracy of analysis, because when the heating power and the source from which the coal comes is known, there is evidence indicating whether or not the analysis has been correctly per-

formed, because, if it has not been, it will be shown by the British thermal unit.

Ash.

An important reason why ash should always be considered as a percentage of the dry coal instead of the moist fuel is, that like the British thermal unit determination, unless it is placed on some common basis, proper comparison can not be made on different lots of fuel; for example, in two samples, the moisture may be eight and thirteen per cent, and ash in the dry coal ten per cent in each, but expressed on the moist coal basis, it appears that one has 8.7 and the other 9.2 per cent of ash, and it would seem that one of the fuels contained more than the other. In this connection the fact should be borne in mind, that no one burns moist coal; the moisture is evaporated and passes away; in fact, dry coal is not burned, the ash remaining; it being the pure coal which enters into the process of making fire.

Size of Coal.

As a general proposition, the value of fuel increases with the size of the pieces, so that a very fine "duff" is of little use, but as the pieces become larger, the actual value increases in a greater ratio than does the heating power, and this continues to egg size and lump. Thus smaller pieces containing the same amount of heat per pound as larger ones, are of less value than the larger coal. (See Mr. Abbott's paper, presented September 5, 1906.)

The size of the pieces of coal exercises an important influence not only on the capacity which may be produced by a boiler, but on the resulting efficiency, and the best size to be used in a given case is dependent upon many conditions, such as the strength of draught, kind of stoker or grates, method of firing, etc., and the selection of the proper size of fuel or the method of utilizing the available size often affords an opportunity to effect important economies.

Sampling.

One feature of the matter, referring especially to coal inspection service, is proper and reliable sampling. In very many cases the coal inspection service is rendered by a company, which, while acting as the purchaser's representative, is depended upon to furnish the seller with reliable reports concerning the composition of coal supplied. Under such conditions, it is absolutely necessary that not only shall the inspecting chemist be both competent and reliable, but that he shall be as fully responsible for the collection of the samples as he is for the analytical report, and it is also absolutely essential that the purchaser or his employees shall not be allowed to sample any coal or assist in the sampling, because under such conditions, the chemist may not know whether the report which he makes is correct or not, and it is well to emphasize the fact that the sampling is of as great importance as the analysis itself.

Referring to the branch of the subject before mentioned as that of research, there has been in operation for some years at St. Louis, what has been designated as a fuel-testing plant, under the direction of the United States Geological Survey. Its principal published work so far, however, has been largely confined to "tests" under boilers, which have been thought to show the "real steaming value" of the fuel. The author's remarks above regarding testing coal under boilers will refer to this branch of the work.

Probably the reference to coal in the plural has done much to cause confusion, because it has led people to believe that there are very many "kinds" of coal. For example, fuel from Herrin and Carterville in this state would, according to this, be considered as different "coals," when, as a matter of fact, they are from the same seam, and the most exact analytical tests so far made do not indicate a difference. The amount of ash associated with the coal may or may not vary, but the coal is the same, and it is coal and not coals, otherwise, every mine would produce a different kind of coal, notwithstanding the fact that seams in Illinois sometimes run through an entire county without it being possible to detect any variation in the quality; therefore, the expression, "kinds of coal," which has been used frequently in connection with coal-testing work, should not only be better defined, but limited in its application to those cases where there is a real difference, which, as is well known, does exist; for example, it must be conceded that anthracite and bituminous are different kinds of coal, but the most liberal application to this coal basin would allow only two kinds, which are the block coal of Indiana, all the remainder being bituminous, the latter also including what is known as semi-block of Indiana.

The State of Illinois has made an appropriation covering cost of investigations to be conducted by the engineering experiment station of the University of Illinois, and there is certain important work which it is hoped will be undertaken, having a bearing on the values of fuel, studies tending to define the laws controlling the influence due to the size when burned with some different kinds of stokers or grates, and similar studies to ascertain corresponding effect due to varying amounts of ash in coal, also degree of fusibility of such ash.

The recently-established State Geological Survey will present by all means a very much better coal report than has so far been published by any state, and it will be a great help to the purchasers and producers of coal, if certain values as affecting heating power, ash and moisture are authoritatively presented. As before mentioned, the three essential items are heating power of the pure coal, percentage of ash in the dry coal, and moisture. The British thermal unit values would be the simplest of the three, as these results would apply to pure coal, and which is, no doubt, practically a constant for a particular locality of a seam, therefore, once determined, it will not be necessary to repeat tests. Establishing ash values would be a more difficult matter, because it would not only involve ash in seams as the coal lies in the ground, but the various grades of fuel shipped from those seams. Ash, however, at the mine would be the same in quantity as when received by the consumer. Securing moisture values would be a far more complicated problem, because of greater variation due to temperature, weather conditions and time in transit. For these reasons, it is difficult to arrive at any conclusion regarding the amount of work which may be justified in the establishment of such values. Some idea of the complication may be illustrated; for example—the washed and sized coal shipped so extensively from Williamson County has a characteristic moisture content due to the difference in the size of the pieces, the larger ones being drier, and these moisture contents vary over wide ranges between summer and winter, and also according to the length of haul; thus at least average moisture values would be needed for each size, at the city where the coal was received.

A recent expression which has come into use is that of "air-dried coal," which is based upon allowing the sample to become dried in the open air of the laboratory, the idea being that this shows the fuel as it would reach the customer. No standard conditions, however, appear to be employed in this air-drying, and if there were, the values obtained thereby do not indicate the amount of moisture in coal when it reaches the consumer. Some samples of air-drying on Illinois coal have shown the moisture as being between five and six per cent, when as a matter of fact, the same coal is never received with less than seven, and in the winter time it is very much more. This moisture value should be abandoned, as it serves no useful purpose, tending only to increase existing confusion and misunderstanding.

INCANDESCENT GAS LIGHTING.

On December 19th L. F. Tooth read a paper before the S. Dist. Jr. Gas Assn., in London, England, from which the "Gas World," (December 22d) made extracts; among them the following will interest our readers:

Speaking of pressure, the author said that he found that incandescent burners working under 3 ins. pressure gave vastly better results than under the old 1.5-in. conditions. "The advantages are: The consumer has more opportunity of getting smaller gas accounts, because, in the event of the burner roaring, or the flame passing over the top of the mantle, it appeals to him at once that the burner requires adjusting and, if under maintenance, he will either notify or take some steps to remedy the error. Pipes can be reduced to half the size of those required for very low pressures, reducing the initial cost and at the same time limiting that ugly appearance that large ones have been running through the building. Complaints of bad lights and stopped supplies are reduced to a minimum. The nipples will not get choked with dust so quickly. The mantle has more chance of adapting itself to the flame and vice versa. It will become well filled and incandescent to the top, reducing shrinkage to a very great extent. Increased pressure prolongs the life of the mantle, as it becomes hardened and crisp after being burned for a short time. To show the increase in efficiency as pressure increased, he submitted tests of a No. 4 Kern burner, different sized nipples being used to obtain the best results at each pressure, as follows:

Pressure Tenths	Consumption of gas Cubic feet	Illuminatng power Candles	Average candle power per cubic foot of gas
15	4.9	90	18.3
20	5.5	103	18.7
30	5.1	100	19.6
40	5.5	120	21.8
50	6.3	142	22.7

"The simplest means of checking the gas supply is at the meter tap, or at each individual point, or a still better method is the 'gas adjusting nipple.' By the use of this nipple, you can obtain an equal duty in every spot. A gas adjuster has advantages over air regulators, because the slightest decrease or increase in the volume of gas creates a rapid change in the lighting efficiency that is at once apparent to the eyesight. It is also very useful in high-pressure lighting, as it is often necessary in certain parts of the building, such as staircases, lavatories, etc., to revert back to low pressure; in this case, the nipple displaces the use of governors. Makers would do well to give their serious attention to this, as it would be the means of relieving them of the necessity of making special nipples for individual companies' districts and entirely do away with the annoyance of stocking different sizes to cope with the local conditions of any individual consumer. In adopting the adjustable nipple, it is very necessary that it should be of very fine manufacture and made perfectly true and with very smooth edges. Better results are obtained from one that has a central adjusting movement, because I contend that gas should impinge from the nipple in the direct center of a bunsen tube and not by shutting off one, two or three of a number of holes, as the case may require. To illustrate the value of the nipple, I fitted a No. 4 Kern burner with one and the photometrical readings were as follows:

Pressure Tenths	Consumption of gas Cubic feet	Illuminating power Candles	Candle power per cubic foot of gas
15	4.4	87	19.7
20	4.7	95	20.2
30	5.2	115	22.1
40	6.0	138	23.0
50	6.3	153	24.2

"Comparing the above figures with those of the ordinary nipple I have given, it clearly proves that the adjustable nipple is going to play a very prominent part in gas lighting.

"In mapping out an installation, in most cases there is no absolute hard and fast rule to work by, such as candle power per foot of floor space, because each individual consumer's requirements and conditions differ. It is really a matter of experience to determine the amount of light required for a given area, but the rule of one candle for every 3 square feet of floor area is a very good standard to work upon, assuming, as a basis, the room to be lighted to have a white ceiling and walls and lights placed 9 feet high, increasing the power according to the color of walls, decorations or obstructions. An increase of 5 to 7.5 per cent in candle power will usually suffice for every foot over 9 feet in height. Color and tints of globes have also to be considered when working to the standard just given. The general public, to my mind, have a great tendency for increased light, which is certainly very harmful and destructive to the eyesight, especially the rays given from the electric arc, which we see so often used for inside lighting. Therefore, this is another point we have to consider in getting our light well diffused in small units, with soft, mellow tone and I always endeavor in inside lighting to tone it down to resemble the evening light, which is very restful and pleasing.

"All lights, as far as possible, should be hung from the ceiling and every endeavor made to have the mantle suspended in a direct line with the cup and ball, so that, when globes or any parts are removed for cleaning purposes, the mantle is left still in the vertical. Tee pendants and all fittings of this class should be avoided, because, according to the weight of removable parts, so the mantle is thrown out of the vertical line. This causes the mantle fringe to break and also strains the loops and shoulders. I estimate these fittings increase the maintenance cost at least 33 per cent. The disadvantage of this class of fitting applies more to the upright than to the inverted burner, as the clay rings take up the strain. Fittings should not be used without a cup and ball pinned top and bottom. Pendant drops over 5 feet should be pinned at every joint, particularly at the tee-piece of bridge under floor and ceiling."

In a brief reference to church lighting, Mr. Tooth pointed out that the fittings should be such as will blend with the building and, if inverted burners are used, provision should be made for some of them to be turned out, as he could not understand inverted burners being lowered, despite what had been said in the "Gas World" in reply to Mr. Fletcher, of the Welsbach company. In regard to factory lighting, he said he thought the inverted burner would, in the near future, play a very prominent part in lighting sewing machinists' shops. He found the Bijou burner, with shade, exceptionally reliable in providing ample light for one machinist dealing with long lengths of cloth and sufficient for two dealing with small work, providing the machines were facing each other and the light placed so that it was thrown on the right side of the needle. As to vibration, to overcome this he had not yet found anything to surpass the elongated spring; compressed or lateral was of no use whatever, and did more harm than good. A fitting suspended from cup and ball, having practically the whole of its weight at the bottom, would take up a certain amount, where buildings were near railways and places where vibration was of a slight character. Fittings suspended by chandelier chain and also flexible metallic tube, took up a considerable amount of vibration, but in the latter case the fitting should be a very light one. In regard to yard, wharf and dock lighting, he said this should be done by units of from 100 to 250 c. p., placed about 12 feet high and the side of the lamps next the river should be glazed with ground glass, as shadows cast upon the water were exceedingly dangerous to river traffic. The 16-inch square lantern was best suited for this class of work, as the wear and tear was heavy and the cost of repairing these lanterns was less than that of the globular type.

"Great care should be exercised in the fixing of lamp arms. They should be run through the facia to the internal

part of the building and secured by means of a plate and back nut, the flange of the arm acting as a stop. It often happens that supplies must be run on the front, on account of roller shutters, sun blinds and large glass facias. In this case a flanged tee-piece will provide the connection for arm and back plate, the arm being stayed to take the strain.

"Lamps require to be of good manufacture and strongly made; and care should be taken not to crowd too much power into them, as this increases wear and tear. Large arc lamps seem to be going out of date and the smaller lamp, 2 feet over all with 11-inch globe, coming into more popular use. There seems to be a great tendency for 4-burner lamps. Why, I cannot understand. You can get practically the same results with 3-light, reducing wear and tear and gas consumption 25 per cent and giving the consumer more satisfaction.

"Cluster lamps should be used in preference to single burner, as you have always a fall back in case of breakage of mantles. All cups and balls should be fitted with safety guards.

"I do not think that maintenance should be run at a heavy loss, even as an advertisement and should certainly return the cost of material and labor. To my mind, supervision, management and establishment charges, is quite sufficient loss to warrant the satisfaction of consumers.

"Details of each consumer's installation should be kept, including position, description of lights and provision made for remarks in the event of any peculiarities, such as excessive vibration, abnormal dust and situation of premises, such as over railways, etc., so that you always have at hand a ready reference for any future occasion. In organizing a maintenance staff, it is absolutely necessary to employ the most skilled workmen available, as on them the working results largely depend. As the result of my experience, I find that it is false economy to employ cheap labor on such delicate work."

RULES FOR INSTALLING GAS PIPING.

Inside Piping.—Almost all architects' specifications now call for the piping in a building to be done according to the rules of the gas company and the gas company usually adopts such rules as will insure that the size of the pipe used will be of ample capacity to carry the amount of gas it is expected will be needed with a differential pressure not exceeding one-half an inch of water. They also specify that the work shall be done in such a manner as to insure as far as possible the safety of the occupants of the building. The following rules for size of pipe for inside piping were adopted by the American Gas Light Association, in 1898:

Diameter, Inches	Length, Feet	Gas per Hour, Cubic Feet
⅜	20	11
½	30	22
¾	50	60
1	70	127
Diameter, Inches	**Length, Feet**	**Gas per Hour Cubic Feet**
1¼	100	222
1½	150	349
2	200	718
2½	300	1,253
3	450	1,977
4	600	4,059

No greater length of pipe should be used than is given in the table; e. g., the maximum length of 1-inch pipe allowable under any circumstances is 70 feet, and it should not be expected to carry over 127 cubic feet of gas per hour.

One of the natural gas companies where gas is largely used for fuel, has adopted the following rules governing the size of the pipe and the method of installation:

Gas for Light.—No pipe less than ⅜ inch.

Size of Pipe, Inches	Greatest Length Allowed, Feet	Greatest No. ⅜-inch Openings Allowed
⅜	12	2
½	30	3
¾	60	10
1	70	15
1¼	100	30
1½	150	60
2	200	100

Gas for Fuel.—No pipe less than ½-inch.

Size of Pipe	Greatest Length Allowed	Greatest No. ¼-inch Openings	Instead of ½-inch Openings there may be ½	and ⅜	or ¼
½	15	1	1	..	..
¾	50	2	1	1	1
1	70	4	2	1	2
1¼	100	8	4	2	4
1½	150	15	6	4	7
2	200	33	14	8	15

All new piping must be tested with a mercury gauge and shall be made tight at a pressure of not less than 4 pounds or 8 inches of mercury. No spring gauges will be allowed. The gas company must be notified of the completion of any job so that it may inspect the same, should it deem it necessary. The riser pipe in any building shall not be less than ¾ inch and must go in an inside partition wall and out of reach of frost, and must not project more than 2 inches below the cellar joist. No traps in the riser will be allowed. Drop or bracket outlets must be securely fastened. Split pipes must not be cemented, but the pipe must be taken out and a perfect piece substituted. No cast iron fittings will be allowed, only the best malleable iron fittings galvanized. In case more than one consumer wishes to use gas in a building a separate riser must be run for each consumer. In no case will a meter be set where the gas passing through that meter must be deducted from another meter through which it has previously passed. Piping shall be so arranged that the meter can be placed in a position easy of access and exposed to neither dampness nor extreme heat or cold. The meter should be placed as near where the service enters the building as possible. Suspended pipe must be securely fastened. No strings, rope or wire should be used.

In addition to the above the following notes may be of interest:

For this work it is advisable to use the best quality of wrought iron pipe obtainable, as this insures that the threads will be cut without stripping and there will be less liability of split pipe. The fittings used are preferably malleable iron, beaded, and the best practice is to use galvanized fittings since the galvanizing has a tendency to fill up whatever sand holes or porous places there might have been in the original casting. For the dope on the threads any one of the various compositions given under "Wrought Iron Main Laying" may be used on male thread only.

Care should be especially taken that all openings are securely fastened. There is now on the market a malleable iron drop fitting having lugs or ears projecting from the side for the purpose of fastening. The use of this fitting makes it easier to fasten the drop and would also prevent the liability of the drop being unscrewed when the fixtures are taken off. No unions should be allowed to be used, as it is almost impossible to make the work come so exact that the two faces of the union will press against each other, making a tight joint without the use of a washer, and unions with which the joint is made by a washer are much more liable to become leaky than long screws. The long screws are cheap and make a joint that is tight or as permanently tight as any other joint.

Testing Inside Piping.—After the piping has been completed it should be tested to see that it is perfectly tight. It is customary for the plumber to first ascertain if his job

is tight, and after making sure that this is the case, to ask the gas company's inspector to make the final examination. The plumber should see that all openings are carefully closed with caps and that the foot of the riser line is stopped. Then at any convenient sidelight attach an ordinary gasfitter's pump and mercury gauge. This mercury gauge should have a column of 15 to 20 inches in length. Air is forced into the piping by means of the pump until the mercury column has been forced up about 10 inches high in the gauge, when the pump is shut off. If the mercury falls there is a leak in the pipe; if it remains stationary the pipe is tight. It is customary to require that the mercury remain stationary for from 15 minutes to half an hour. If the mercury falls rapidly it will indicate there is quite a leak and this leak will be heard to blow. If the leak is caused by a piece of split pipe or split fitting the pipe or fitting should be removed and a new piece substituted. Gasfitter's cement should not be used for repairing leaks. If the leak cannot be heard blowing, either may be put into the hose of the air pump and the pumping of the air into the pipes will carry the ether into the pipe. The odor of the ether escaping will indicate where the leak may be found in the pipe and it may be definitely located by means of a strong soap water applied with a brush or sponge. The liquid is rubbed over suspected joints or fittings and air bubbles are blown by the escaping air. In very large work it is advisable to prove one floor or one section at a time and when all are done connect them with the riser and prove as a whole. If the pipe to be tested has been previously used for gas and you have to test for leaks, it will be necessary to take off the meter and cap the bottom of the riser; also to take off the gas fixtures and cap the outlets carefully, as it is impossible to test pipe with the fixtures on and find it tight. The ground joints in the stopcocks of the fixtures almost always leak when the pressure is put on them. Sometimes plumbers, when they have a small leak and are unable to find it, or if it is concealed in a partition where it is impossible to get at it to repair, will fill up the house piping with water containing salt or ammonia solution, hoping by this means to rust the leak tight. They are almost always successful in doing this, but the practice should be condemned, for after the water has been drawn out of the pipe the ammonia and salt still continue to rust the pipe and in time this rust will collect in some one place and stop up the system.

Some gas companies require that the gasfitter file at the gas office a sketch or plan showing the size pipes run and the length of each piece. This plan is filed previous to inspection. The company's inspector checks up the sizes to see that they comply with the rule. He afterwards examines the piping in the house before it is concealed, and if the piping is according to the rules of the company he gives a certificate to the effect that he has inspected and found it to be tight and to comply with the company's specifications. It is stated, however, in the certificate that the issuing thereof does not insure its future soundness. At the time of the setting of the meter, or at the time when the gas is turned on, a second inspection is made, this time of both the pipe and the fixtures, and in case these are found tight the gas is turned on.

FUTURE DEVELOPMENT OF HEAT ENGINES.

By E. N. Percy.

The interesting and able contribution by Prof. Burstall, in "The Gas Engine," was read with interest by the writer, who is studying the subject in Germany.

Prof. Burstall, in common with many, assumes that large powers for gas engines are most successfully incorporated in huge horizontal, slow-speed engines, closely resembling, in design, the steam engines of a decade ago. Why not make use of high-speed multi-cylinder, vertical engines, and borrow a little knowledge from modern steam engine practice? The best running and most economical steam engines we have at present (though not the cheapest) are the single action. They run silently, because the forces are always in one direction. This type applies also to a two-cycle gas engine and is even more economical, because the cylinder temperatures remain almost the same, there being no reversal of temperatures.

The fact that a gas engine is to be treated as a gun in design because of high initial pressures, and that governing is a complicated problem, can be overcome by the same methods; i. e., substitute those neglected and abused types of engines in which the fuel, liquid or gas, is injected after the air, and during the power stroke, and burned as injected, whether by high compression, hot tube or continuous electric spark, it makes no difference. Then, there will be no explosion, nor any increase of pressure above compression, and the fuel supply can be governed exactly to suit the load, and governing is as perfect as in the steam engine. The various engines of this type now on the market are by far the most economical we have, some running on fifty per cent. of the fuel of an ordinary four-cycle gas engine.

In regard to the gas turbine, Prof. Burstall assumes that seventy-five per cent. of the output does negative work. To overcome this objection, could not all this heat be rejected into the pumps, and various parts of the turbine be made to boil water, and the same injected into the turbine, as in a certain well-known make of engine, and there, by actions whose result only is known, render the turbine quite economical? Furthermore, the "pumps" to which reference is made, would, of course, be rotary turbine-pressure blowers, or air compressors, through which air passes so quickly that the losses might not be as large as expected. As to the cooling of the blades, it can be done in any one of several ways, but whatever method is used, the heat must be saved, and, in the writer's opinion, used over again, instead of passed to another machine. This could be done, by using it for steam, to heat the incoming charge, or to heat a low-boiling liquid to run a turbine on the same shaft, possibly built around the main turbine, so as to absorb its heat.

As to the reversibility and flexibilty of the gas engine, a two-cycle, three-cylinder, vertical engine, of the fuel injection type, in combination with compressed air and cocks to let the starting charge of compressed air in through the fuel valves, will start, handle and reverse with all the ease and certainty of the steam engine, and all with the handling of one lever.

The writer has actually seen this done, and knows whereof he speaks.

In looking over the past, we find the greatest progress has been made by those who disregarded conventionalities and the opinions of the ever-present "let-good-enough-alone" types, and arbitrarily "did it." No doubt many people told Diesel, Meitz and others that their engines would never work. No person should ever ridicule an idea, and the practical man who laughs at ideas will in a few years regret it. Hence the writer's frank admiration for those who, like all scientific men, look into the future, and speak boldly of it, and discuss it freely. Invention is not a matter of genius, but becomes more and more the result of scientific evolution.

ELECTRICITY ON THE FARM.

Not content with his several crops a year and other manifold advantages, the western farmer is preparing to harness a multitude of miniature Niagaras which leap downward from their sources in the mountain tops, and make them generate enough electricity to render the arduous tasks of agricultural endeavor mere child's play.

Though the idea may appear impracticable at first blush, any electrical engineer familiar with the power of mountain streams will admit that it is not only possible and, moreover, feasible, but that its possibilities of application are as limitless as electricity itself.

Many of the richest grain and fruit farms in California are situated on the slopes of the Sierras which create the fertile valleys in all parts of the State. The fruit, grains and vegetables grown on these mountain farms is said to possess a richer flavor and command a better market than that which is garnered from the widespreading lowlands, but the mountain agriculturist suffers handicaps from which his brother of the valley has hitherto been exempt.

There are certain mining districts which would be the richest in the world if they could be worked to advantage, but which, under present conditions, are almost profitless. The same may be said, in a small degree, of all western mountain farms, for though, even under adverse conditions, they yield a good return, they would net their owners a tenfold larger return with the benefits the electrical farming movement hopes to develop.

The movement, moreover, is far more than a theory. It is a practical reality on a small number of farms and its scope is being so rapidly extended that another decade may prove the electrical farm the rule rather than the exception in the Golden State.

What electricity will do on a farm may be seen in Solano and several other counties in California. In one instance, the farmer had command of a small stream with about 4,000 gallons flow per minute under normal conditions. A flow-type dam, 30 feet long and 4 feet wide, was built across the stream, the water being diverted through a ditch about 100 feet long, giving a fall of five feet. At the lower end of the ditch, a wheel pit, laid in concrete, was constructed and over this a small power house was built. In this a 30-inch water wheel was installed which operated a dynamo of 12½-kilowatt capacity. This is a plant which runs all the year around, requiring only a little attention twice a week. It is equipped with a governor which regulates the electricity according to the demands made, but it never stops, night or day, and at any time the turning of a switch furnishes light, heat or power.

Primarily used to lighten the labor of a dairy, it was but a step to attach a belt to the grindstone and install an electrically operated buzz-saw that made the cutting of the winter wood comparative child's play. The "women folks" were next made beneficiaries of the subtle power which the little stream so blithely developed and electric lights did away with the labor of caring for kerosene lamps; a motor was attached to the sewing machine and backache banished from the housewife's ills; electricity operated the windmill and filled the tank with water when the days were provokingly calm; an electric flat-iron made its appearance; electrical fans cooled the house in Summer and electrical heaters made it comfortable in Winter.

One would think that the possibilities of usefulness for this little mountain stream were about exhausted with the above list of conveniences, but the fact is that, on the contrary, they have only begun to be suspected. The most important use of all has not yet been broached; i. e., the supplanting of horses by electrically driven farm implements and by so doing to so simplify the work that one man may perform the tasks of three under ordinary circumstances.

It is estimated that three farmers may build, for an outlay of $1,500 each, a power plant of sufficient capacity to do all the work on their combined farms at a saving to each of $900 per year in hard cash and many times that amount in comfort and convenience to all concerned.

THE STRENGTH OF ELM, OAK AND LOCUST INSULATOR PINS.

At the request of certain consumers, the Forest Service recently made tests on fifty-three insulator pins of rock elm, live oak and black locust. The tests were made at the timber-testing station of the Forest Service at Purdue University, Lafayette, Ind. The results indicate the relative strength of the pins tested. They depend upon too small a number of tests, however, to show in an authoritative way the relative value of these woods.

The pins were of standard size, one and one-quarter inch by eight inches. The oak pins were from one-eighth to one-quarter inch shorter than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about one-half inch shorter than in the cases of the other two species.

In testing the pins an iron block was clamped to the fixed upper head of a small screw-testing machine. The pins were inserted to a tight fit in a hole in this iron block, and projected horizontally over the pulling head of the machine. The glass insulator was unable to bear the strain of the wire, so an iron model of the ordinary glass insulator was screwed on the pin and connected by means of a heavy wire to the pulling head of the machine. When a strain was put on this wire, the pin acted as a beam fixed at one end and loaded at the other, which is practically the condition met with in practice. The breaking moment (maximum load times lever arm) is taken as a measure of the strength of the pins. The iron block mentioned was used in preference to a wooden cross arm for supporting the pins, for the reason that this iron block forced the pins to break under the test. Furthermore, it furnished uniform conditions for all pins. Thus, the results of the tests do not show the strength of a combination of pins and cross arm, but they show the bending strength of the pin itself.

The following table gives the results of the tests:

Species	No. of tests		Weight of pin Grams	Rings per radial inch	Breaking moment (Max. load x lever ar m) (Inch pounds)
Black locust,		Avg.	106.3	12	3970
from Boston,	23	Max.	119.3	25	5380
Mass.		Min.	86.6	3	2520
Black locust		Avg.	125.9	8	4087
from Nashville,	7	Max.	147.1	11	4930
Tenn.		Min.	111.8	4	3010
Rock elm		Avg.	93.8	42	2512
from Nashville,	8	Max.	108.7	48	3150
Tenn.		Min.	77.5	33	1450
Live oak		Avg.	127.1	Not dis-	3025
from Houston,	12	Max.	141.0	tinguish-	4590
Texas		Min.	110.4	able	1990

From the table it appears that the breaking strength of the two shipments of black locust pins was practically the same, and may be taken as 4,000 pounds. Live oak pins came next in order of strength, with a breaking moment of about 3,000 pounds. Rock elm pins were the weakest, having a breaking strength of 2,500 pounds.

The oak pins were the heaviest, the locust next, and the elm the lightest.

The locust and elm pins failed mostly by splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by shearing horizontally. The oak pins nearly all failed by tension at the shoulder.

Mr. Bonaparte, Secretary for the United States Navy, has laid before Congress plans for a battleship similar to the Dreadnought. The chief dimensions of the new vessel are: Length, 510 feet; beam, 85 feet 2⅝ inches; draught, 27 feet; displacement, 20,000 tons; coal capacity, 2,300 tons; speed, 21 knots. The plans have been prepared by the Bureau of Naval Construction. The ship will have a broadside 5.25 per cent more powerful than any battleship yet built, and the elevation of her guns will also be greater than is the case in any other vessel, thus giving her increased long-range fire. Her defensive qualities will also be distinctly superior to those of most modern vessels of her class. The armament will consist of ten 12-inch guns and fourteen 4-inch quick-firers, besides a number of small machine guns to repel attacks by torpedo boats. The cost of the vessel is estimated at $6,000,000.

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EDITORIAL.

Engineering and Labor

There is probably no question before the people of this country at the present time of greater importance than the proper remuneration of the working man and the relation of labor of every character to the financial interests. The past five years have been a period of remarkable prosperity and development. Engineering in some form or another has been identified in a marked degree with this material development. Enormous sums of money have been expended, and labor has been in great demand to carry out the large projects connected with engineering enterprises of a magnitude heretofore unknown.

Engineering has always been an important agent in increasing the wealth of mankind and the independence of laborers and mechanics has been greatly advanced in consequence of the vastly increased demands upon their services due to engineering work. Great as have been the strides in engineering, the advance in the progress of civilization has been equally important. In 1834 laborers attempting to form a trades union were sentenced to seven years penal servitude. In England two centuries ago carpenters and masons working twelve hours a day received 24 cents in wages, while common laborers received 16 cents a day. Due to the lack of transportation the prices of every commodity varied widely throughout the country and ranged considerably above the present prices. Meat was practically beyond the reach of the poorer classes. These conditions continued until near the end of the eighteenth century, when there began in England the slow progress of an industrial revolution which has continued with ever-increased intensity in all civilized countries to the present day, and this industrial development has changed the whole course of civilization.

The invention of the spinning-frame and the spinning-jenney multiplied the product of cloth per weaver at least twenty times. Watts' double acting steam engine gave an immense impetus to the factory system. Whitney's cotton gin resulted in giving to the entire world cheap cotton. In 1807 Fulton, and in 1825 Stevenson, gave to the world the result of their work, which has given to civilization cheap transportation. Early in the nineteenth century the invention of the hot blast greatly increased the output of iron products, and at the same time materially reduced the cost of production. A few years later the invention of the telegraph, harvesting machines, and new machine tools for iron and wood working increased the demand for men trained in the elements of engineering. About three quarters of a century ago, therefore, witnessed the introduction of what is now the most important machinery of industry, and upon which our modern civilization to a large extent depends.

There can be no question that the one invention which has been of the most importance in modern life is the steam engine. Its application to transportation both by rail and water would, independent of all other applications, probably give the steam engine first place among all inventions. All wealth, say some economic writers, is the product of labor. If the labor meant is human labor only, the above statement is not absolutely correct. Human labor produces wealth when properly directed in utilizing the natural forces of nature, but the same is equally true of the labor of horses, water wheels, or the steam engine. In Great Britain it is said that steam does more work than could be done by 150,000,000 men, and in the United States steam power is said to accomplish more than 250,000,000 men. In America, during the last twenty-five years, the use of steam power has increased nearly three times as rapidly as has the population. Steam, water and electric power is constantly increasing the wealth of the country. If as is said the increase of wealth in the United States at the present time averages $10,000,000 daily, steam, water and electric power must be given credit as primarily responsible for a large part of this enormous sum.

In 1880 the average annual wages in the United States for each factory employe were about $350. Ten years later they had increased to nearly $500. Statistics at the present time indicate that the average annual wages of the employe of the manufacturer are nearly $1,000. The total value of the products of all manufactures has increased since 1880 about 150 per cent, while the wages paid have increased 200 per cent. From 1890 to 1900 the population of the United States increased approximately 25 per cent. During this same period carpentry products increased 200 per cent. Men's clothing manufactures increased 80 per cent. Foundry and machine products increased 92 per cent.

Iron and steel products increased 85 per cent. Lumber and mill products increased 73 per cent, while planing mill products increased 150 per cent. Masonry, brick and stone increased nearly 900 per cent. Printing and publishing increased more than 200 per cent, while the output of the meat packing houses increased 86 per cent.

The only conclusion to be drawn from the above figures is that the products of what are for the most part engineering enterprises have increased in total value far greater than the increase of population. The increase in wages compares favorably with the increase in the value of the manufactured products, and in as much as these manufactured products consist of raw material to which manual labor is applied, it is apparent what an enormous benefit the increased use of machinery has been to improve the wages of the working men and increase their comfort of living.

There can be no question in the mind of any intelligent man that engineering is the greatest cause of the increase of wealth in the last century, and yet there has always been more or less opposition by the working men to the introduction of new machinery. As late as 1867 a British commission reported that restrictions had been placed upon machinery by trades unions, which restrictions were based apparently upon the idea that there was only a certain limited amount of work to be done in the country, and that if any man increased the amount that he did, whether by the use of machinery or otherwise, he was thereby robbing some one else of the opportunity of working. Nevertheless, the effect of the introduction of labor saving inventions and engineering appliances has been to benefit the working man. This is most conclusively shown by the actual necessity that exists that capital or wealth cannot accumulate except by the employment of labor, and the more wealth is increased by the development and utilization of nature's resources, the greater still must be the demand for labor.

REINFORCED CONCRETE AQUEDUCTS.

The use of reinforced concrete for carrying water is extending, and there are now several instances of the application of this material for aqueducts. One of the most notable is that used in connection with the Simplon Tunnel works in Switzerland. To carry water from the River Rhone to the power plant, a conduit consisting for part of its length of a concrete-steel flume and for the remainder of its length of a cylindrical steel penstock was employed. The concrete-steel flume was rectangular and 1.9 m. by 1.9 m. (6.23 ft. by 6.23 ft.) in section, and was 2 km. (1.86 miles), with a grade of 1.2 m. per kilometre. The roof of the conduit was designed to carry a superimposed load of 800 kgs. per square metre (164 lbs. per square foot), and an internal upward pressure of 300 kgs. per square metre (61.5 lbs. per square foot). The flume is supported on piers of masonry or bents of concrete-steel spaced 5 m. (16.4 ft.) apart. To provide for expansion and contraction during construction, open joints were left over the piers; these were filled before turning the water into the flume. With the water in the flume there is very little expansion or contraction of the structure. The few leaks from percolation were soon closed by the lime in the water. The cost of the flume was 100 francs per lineal metre, or only about 10 per cent more than the estimated cost of a wooden flume of the same dimensions.

WIRELESS TELEPHONY.

It is reported in the Paris journals that M. Maiche has made a further discovery in the field of wireless telephony. His apparatus consists of two posts, which are placed in his premises. Each post consists of a telephone, battery, a special form of induction coil, and a frame which is formed of a series of insulated wires. One post is placed in the garden, and a second one in a room in the building some distance off, about 100 feet, and several walls, doors, and windows come between the posts. Conversation can be carried on easily, and the sound is clear. M. Maiche started to work on this question about five years ago. At the chateau of Marchais he made experiments, using the earth as a conductor, and these were successful at a distance of two miles. One year later he was able to communicate between Toulon and Ajaccio, in Corsica, over the sea, at 180 miles distance, using the sea as a conductor for the waves. The new apparatus, however, works without the use of ground, and M. Maiche expects important results to follow from its use, and also to increase the distance indefinitely by giving more power to the apparatus. It is thought that the system could be used with advantage on submarine boats. In spite of the reported discovery, there is nothing to show that any practical progress has been made.

TELEGRAPHS IN INDIA.

The whole of the telegraphic system of India is to be overhauled and put into a better condition. A committee, which is now holding its preliminary sittings at Simla, is to make a tour of inspection throughout the country. There are over 200,000 miles of telegraphs in India and about 2,000 telegraph offices, but complaints have been made of the inefficiency of the service. The Deputy Controller of the central telegraph office, London, has been sent out to India to give assistance in reorganizing the service.

LAMPS.

The Franklin Institute has published a pamphlet containing the report of the Committee on Science and Arts, on the William J. Hammer collection of incandescent lamps, which was exhibited at the St. Louis Exhibition in 1904. The collection was started in 1879 and contains lamps showing practically every step in their development, from Edison's early platinum thermostatic regulator lamp to the new lamps of the present day. The report contains extracts from letters written by eminent men prominent in electrical science and development, congratulating Mr. Hammer on the historical value of his collection.

What Mr. Hammer's own ideas are, are admirably stated in the editorial note which supplements the report. This is as follows:

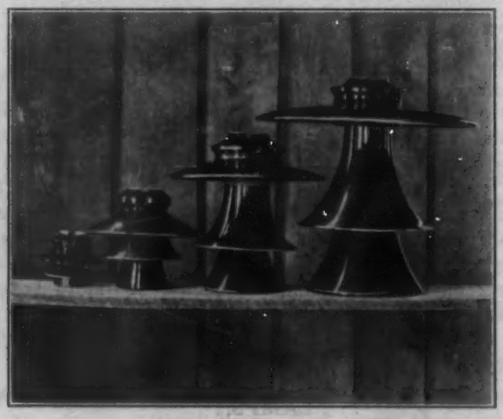
"It is Mr. Hammer's earnest wish that this collection shall be kept absolutely up-to-date as time passes, that it may always represent a complete History of An Art, and to this desirable end he will always lend his enthusiastic cooperation. This has always been his wish and intention, and in the years past he has been buoyed up in his laborious task by the hope that his work, if successfully carried out, would stimulate others to make similar collections forming priceless records of the inception, development and perfection of other arts, and perhaps ultimately result in an engineering museum in which engineers could deposit their models and inventions, where they would be properly safeguarded, where they would be of infinite interest to the world at large, where they would be of great service to the historian, where they would be a constant stimulation to the young engineer and to the inventor, and where they would be of enormous educational value to all engineers.

INDUSTRIAL

THOMAS HIGH TRANSMISSION INSULATORS.

In the development of high-tension transmission lines and the work that has been accomplished in this direction within ten years, no one item has been a greater factor than the high tension insulator.

About 1896 the R. Thomas & Sons Co. of East Liverpool and Lisbon, Ohio, who have been engaged in the manufacture of electrical porcelain for low tension work for many years, began investigation of the question of manufacturing a high-grade porcelain insulator for transmission work. Before attempting to put any of these insulators on the market they thoroughly investigated the situation to ascertain what would be expected of the insulators and learned that the conditions would be most severe, both mechanically and electrically. While such porcelain as they had made in the years past was recognized as standard quality, the process of manufacturing



THE FOUR INSULATORS SHOWN ABOVE RANGE IN SIZE FROM 5 TO 21 INCHES IN DIAMETER AND FROM 5 1-8 TO 18 5-8 INCHES HIGH.

for high tension work was an entirely new problem. They therefore began, and carried on, for upwards of eighteen months, experimental work, to secure a body and glaze that would bring about the result desired, namely, a highly vitrified insulator, homogeneous and capable of standing great electrical strains, and, at the same time, show unusual mechanical strain. Their efforts were in the direction of testing out all known clays, both domestic and foreign, and after a long series of experiments, they found that the high-grade foreign China clays gave the best results. In 1897 they developed one or two sizes of insulators not larger than 6 inches in diameter, and these were placed and operated successfully on lines ranging in voltage from 10,000 to 22,500, and so far as the company knows are operating successfully at the present time. The designs then brought out, however, were found later to be entirely inadequate for higher voltages, as all engineers, as well as manufacturers, seemingly had in view, in the early stages of this development, insulators with great creeping surface, failing at the time to take into consideration arcing distance or air space. However, all of this work led up to a very much greater development, and in 1903, the Thomas people issued their first high voltage catalogue covering about thirty designs for voltages ranging from 5,000 to 60,000, although at that time the 60,000 volt lines were not numerous. The requirements since then have created a demand for insulators capable of carrying 100,000 volts for long distance, and commercial insulators to supply this demand have been furnished. At the same time experimental work is being done on insulators capable of higher voltages—even up to 150,000 volts. The great progress which has been made in this line is shown by the fact that the Thomas catalogue of 1903 included only about thirty designs, while at the present time this company have on the market over one hundred distinct types and practically every type has been placed in service.

To go more fully into the subject of manufacture, we believe that the first insulators made for transmission lines were of a solid piece of clay, while the R. Thomas & Sons Co., in their early experimental stages, worked along the lines of making the insulators in separate shells. It is a fact well known in the art of pottery that a thin piece of clay can be moulded and vitrified more satisfactorily and more free from cracks and flaws than a thick piece, and it was for this reason that they worked along these lines. The firing of these shells is a very important factor and detailed uniformity and proper thicknesses were worked out first in order that they would properly withstand the firing, maintain their shape, and retain the proper and uniform thickness to give mechanical strength.

Another important feature that enters into the manufacture of high voltage insulators, is the thorough electrical testing of them in order that all flaws and imperfections may be discovered before they are placed in service. In the early stages of manufacturing, The Thomas Company installed a testing set with a capacity of 60,000 volts. This, however, was found inadequate within a year, and new testing apparatus was installed capable of from 120,000 to 150,000 volts and of about 40 kilowatt capacity. Two years later, the business had grown, and the requirements in the way of tests had become so much greater that it was found necessary to install still a larger testing apparatus, and they, therefore, placed in operation a 200 kilowatt capacity set, capable of from 200,000 to 250,000 volts. With this testing plant, some other interesting features have been brought out, particularly in placing the insulators under severe conditions, such as heavy rain storm

SEPARATE SHELLS OF INSULATORS READY FOR GLAZING.

A CORNER IN THE KILN SHEDS.

tests, etc., to ascertain at what point various types of insulators would arc over or the current jump around from the wire to the supporting pin.

In cut No. 1 is shown an insulator designed by Mr. R. D. Mershon, for use on one of the lines for which he was consulting engineer. This insulator, as shown, was placed in position on a metal pin with one wire through the top groove and around tie wire groove and the other wire fastened to a metal pin at the bottom of the lower petticoat with approximately ¾-in. precipitation of rain on the insulator; a voltage of 100,000 was turned on it and this gradually stepped up to 130,000 volts, when the current arced around from wire to wire, but no injury was done to the insulator.

This same insulator was then placed in position as shown by cut No. 2 on a large metal pin for mechanical test. Heavy pieces of casting were used for this test and smaller pieces of metal added until the weight had reached 4,225 pounds when indications were that the pin would soon bend. While this weight was being sustained by the insulator, as shown by the photograph, current of 160,000 volts was applied. This was for the purpose of ascertaining if any electrical defect was produced by placing the insulator under severe mechanical stress. Nothing occurred to affect the insulator in any manner whatever, although the pin gradually bent until the castings touched the floor at this weight.

This same insulator was then placed in the testing bath and current turned on and raised until it reached about 186,000 volts, when it arced over; this test could be carried no further, as it had reached the arcing point.

FROM THE BABY TO THE GIANT. SHOWING RANGE OF SIZES MANUFACTURED BY THE R. THOMAS & SONS COMPANY.

None of the tests above described affected the insulator in any way.

Cut No. 3 shows an insulator designed for and put in use on the Necaxa plant of Mexico, of which Dr. F. S. Pearson is the consulting engineer. This insulator was put under rain test of three-quarter inch precipitation per minute, and for this test, we are indebted to Mr. C. C. Chesney of the Stanley G. I. Company of Pittsfield, Mass. The test was made in a dark room, and after the insulator had been thoroughly wet with the rain sprayed from various angles a current was turned on and voltage raised until it reached 96,000 volts, when it flashed around from wire to wire.

This insulator also has been given a mechanical test of about 3,000 pounds.

Another very interesting test given on the insulator, shown by cut No. 3 was the following:

1st. Clean and dry;

2nd. With water sprayed on at an angle of 30 to 40 degrees;

3rd. With insulator enveloped in steam from boiler;

4th. With insulator enveloped by steam from salt water.

In all of these tests, the cross-arm was 4¾ inches below the bottom petticoat.

CUT NO. 1.
UNDERGOING A PRECIPITATION TEST OF ¾-INCH PER MINUTE, AT 130,000 VOLTS.

Test No. 1. Insulator was put in a position approximating line conditions. Under these conditions, at about 140,000 volts, there was a noticeable play of "static" about the upper part of the head. The voltage was then raised to 180,000, which was as high as they cared to go with the apparatus at hand. Although the insulator at 180,000 volts did not arc over strongly, there was a spitting or crackling spark now and then which appeared to extend from the line wire to the iron pin following the outline of the insulator in its course. Although the voltage could not be raised, it appeared that the insulator was about on the point of arcing over.

Test No. 2. In this test, the water was forced through a nozzle and spread out over the entire insulator, striking it with considerable force at an angle of about thirty-five or forty degrees. It was hardly fine enough to be called a spray and struck the insulator with sufficient force to spatter considerably. Under these conditions, it took 101,000 volts to arc over the insulator.

Test No. 3. In this test, the insulator was in an enclosure about 6x7x8 ft. high. There was a door about 6x3 ft. leading into the testing room from the enclosure. Steam was sent into the enclosure from the boilers in the engine room. While the insulator was fully enveloped by the steam, it was

CUT NO. 2.
MECHANICAL TEST.

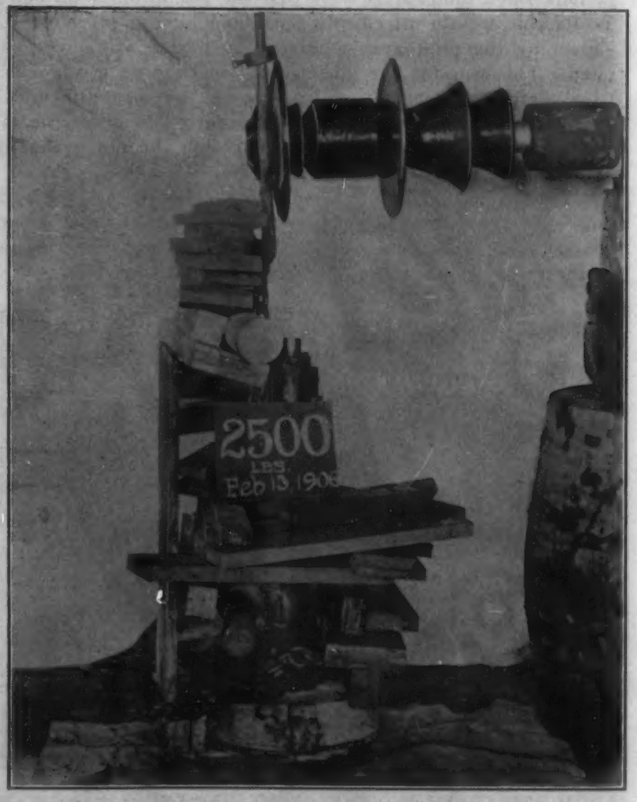
impossible to get it to arc over at 180,000 volts, but on applying voltage to the insulator within a few seconds after the steam was turned off, about 140,000 volts was all that was necessary to arc it over. However, by waiting still longer before applying the voltage, it took about as high a voltage to arc it over as if the insulator were dry. In about five minutes after the steam was turned off, 180,000 volts was applied to the insulator without arcing it over. At this voltage and under these conditions, there was a play of static all over the insulator from top to bottom. With the insulator enveloped in steam, there was very much crackling at 170,000 volts, but it did not arc over at 180,000 volts. It should be noted here that although the insulator was not visible on account of the steam surrounding it when there was no voltage applied, it could be very clearly seen when the high voltage was applied. This high voltage seemed to clear the fog around the insulator. During this test, the insulator was slightly warm.

Test No. 4. In this test, with the salt fog, the steam was not forced into the enclosure under pressure as in the previous test. About three feet below the insulator and a little to one side, was placed a galvanized iron wash tub containing about five inches of water and more salt than the water would dissolve. Under this tub was placed a large gas burner in order to boil the water. After the water boiled vigorously for about twenty minutes, the test was made. Owing, probably, to openings around the side of the enclosure, it would not fill up with steam as much as was desired, even when the door was closed. However, the steam floated up around the insulator so that salt was easily detected by placing one's tongue to the insulator before the current was turned on. Around the vertical part of the head of the insulator there was a film of condensed moisture. So much heat was necessary in order to boil the water that the insulator was heated up quite noticeably during the test. Under these conditions, the insulator arced over at about 180,000 volts. This test was conducted

CUT NO. 3.
UNDERGOING A PRECIPITATION TEST OF ¾-INCH PER MINUTE, AT VOLTAGE OF 96,000.

in the presence of Mr. R. H. Dillon, representative of the Mexican Light & Power Company, New York City.

In the demand which seems to be growing for insulators for extreme high voltages, and in the direction of producing an insulator for working voltage of 125,000 to 150,000, the R. Thomas & Sons Company, as practical potters, realize that it is impracticable to extend the diameter of insulators to much



CUT NO. 4.
MECHANICAL TEST.

greater extent than eighteen or twenty inches, owing to the trouble given in the drying and firing process in keeping them straight. They therefore worked out a new insulator which is shown in Cut 4. When first presented to some of the leading engineers they were inclined to question its mechanical strength. Therefore, as shown by Cut No. 4, a mechanical test was made, using weights as described in Cut No. 2, and after placing 2,500 pounds on the insulator the pin bent to such an extent that they could go to no higher weight.

Later a mechanical test was made in the presence of Mr. F. O. Blackwell and Mr. Cooper, and carried to a point of 3,500 pounds, under which weight the pin bent so much that it came in contact with the center. As yet no accurate data has been secured as to the electrical capabilities of this insulator, although some very high tests have been made on it; but, through the courtesy of Mr. R. D. Rushmore of the General Electric Co., of Schenectady, an elaborate test will be made with their 500,000-volt apparatus, result of which will be given later; preliminary tests made by the manufacturer satisfy them of their ability to produce an insulator for any voltage that may be required.

One point in connection with the Thomas high-transmission insulators which deserves special attention is the perfectly smooth, bright glaze. Electrical engineers all agree that this is a very strong feature and tests have shown that, beyond all contradiction, this glaze is absolutely free of leads or any oxide which would prove a detriment in electrical work. It has also been agreed by electrical engineers that the requirements of high-transmission insulation can only be produced by practical potters of unquestioned experience and ability, and when it is considered that the Thomas family have for three generations devoted their entire time to this industry it is safe to assume they are particularly well qualified for the work. They have been particularly fortunate in this development in receiving the sincere co-operation of leading electrical engineers, both in this country and Canada, and it is largly due to this co-operation that they have been so successful in placing upon the market, not only numerous designs, but designs which have been proven successful under trying conditions.

CUT NO. 5.
TESTED INSULATORS READY FOR PACKING.

COKE AND GAS COMPANY TO EXPAND PLANT AND THEN INSTALL ELECTRICITY.

The directors of the San Francisco Coke and Gas Company decided at a recent meeting to increase the capital stock of the company from $5,000,000 to $10,000,000, and also to increase the bonded indebtedness of the company from $2,500,000 to $7,500,000. President Leopold Michels, of the company, said recently that the directors recommended such action to enable the company to extend its mains, the gas plant, and also to install a plant to manufacture and furnish electricity throughout San Francisco.

He also said, when asked, that the proposed increase in the capital stock of the company and its bonded indebtedness had no connection with the merger contemplated or under negotiation by other companies, and that his company had no connection with any proposed merger. The stockholders of the company will hold a meeting Monday afternoon, March 25th, in the company's office, to vote upon the proposed increase of stock and bonds.

RECEIVER FOR THE NATIONAL WIRE CORPORATION.

A receiver has been appointed for the National Wire Corporation, of New Haven. The liabilities are given as $2,000,000. The plant at New Haven is operated in conjunction with the National Steel and Wire Company, a Maine corporation operating mills in various cities, and which is one of the largest telegraph and telephone wire manufacturing concerns in the country.

Evidently the numerous branches of the H. W. Johns-Manville Company are inadequate to properly supply the demand for its asbestos and magnesia products and electrical devices. On January 1st a branch, consisting of a large retail store, offices and warerooms was opened in New Orleans, in the large three-story building located at the corner of Baronne and Perdido streets. Mr. W. E. Carpenter, formerly local manager of the Western Tube Company, will have charge of this branch.

NEWS NOTES

FINANCIAL.

New York.—The Great Western Power Company of California has filed a mortgage to the Central Trust company of New York as trustee to secure an issue of $25,000,000 five per cent. gold bonds, dated July 1, 1906, and due July 1, 1946, but subject to redemption after five years at 106 and interest. Of this issue $8,500,000 is outstanding. The Great Western Power Company was recently incorporated under the laws of California, with an authorized capital of $25,000,000 as the operating company for the Western Power Company of New Jersey. The latter is a holding company with $18,000,000 authorized capital stock. Edwin Hawley is president of the company.

San Francisco.—The Supreme Court has handed down a decision in the case of the Anaheim Union Water Company and the Santa Ana Valley Irrigation Company against C. B. Fuller, C. H. Fuller, Fred Zucker and F. J. Smith, that embodied two sweeping rulings in the irrigation matter. The case originally arose when the irrigation company protested against the diversion by the defendants of water from the Santa Ana River to lands not riparian to the river. Several questions of interest to farmers and irrigationists throughout the State were passed upon by the court in the decision, notably the matter of watershed rights and the inability of landowners not riparian to claim riparian rights to lands which they acquired from owners who had their holdings along streams from which irrigationists had the right to draw water. The opinion was written by Justice Shaw, and is comprehensive and pertinent in the matters of which it treats. The action originated when the irrigation company complained and sought an injunction against the four defendants, who were located above them on the Santa Ana river. The decision of the court upheld the finding of the Superior Court, which had sustained the plaintiffs in the initial action. In regard to the portion of the decision that settled the rights of riparian landowners as to lands not embraced in the watershed of the stream to which the lands were adjacent, the court said: "Land which is not within the watershed of the river is not riparian thereto and is not entitled as riparian land to the use or benefit of the water from the river, although it may be a part of an entire tract which may extend to the river."

INCORPORATIONS.

Los Angeles—The Las Flores Water Company has been incorporated with a capital stock of $96,000, by J. W. Hughes, D. Galbraith, G. A. Soortwout and Peter Gano.

San Francisco.—The California Traction Company has been incorporated with a capital stock of $100,000, by E. A. Philips, J. J. Srivner, D. B. Richards, J. W. Scott and G. E. Philips.

Globe, Ariz.—The Globe Electric Gas and Water Company has been incorporated with a capital of $750,000, by C. N. Bassett, B. A. Nebeker, A. W. McPherson and others. The principal place of business is at Globe, and an office will be kept in Los Angeles.

Chihuahua, Mex.—The Cia Agricola de Fuerza Electrica del Rio Conchos is the name of a corporation formed in Mexico City, with a capital of $10,000,000, to take over the electric power and irrigation enterprise about 22 miles from Santa Rosalia on the Conchos River. It means the distribution of power to this city and Santa Eulalia and to Jimenez and Parral. A great dam will be built to form a lake covering thirty square miles. The local street car company will get its power for the proposed line here. A more complete description of the Conchos River enterprises will soon be published.

ILLUMINATION.

San Francisco.—A contract has been made between the San Francisco Coke and Gas Company and the Stanislaus Power Company to undertake to supply the people of San Francisco with electric light and power as well as gas. The following announcement has been published by the San Francisco Coke and Gas Company: "The public having by their patronage approved our principles of supplying the best of gas at reasonable rates, we have determined to enter the field of supplying the public with electricity. With this end in view we will immediately commence the construction of an auxiliary power plant, utilizing for that purpose part of the property now used as a gas plant at North Beach, and have entered into an advantageous agreement with the Stanislaus Power Company for the exclusive use of its power as soon as its transmission plant is built. The plant to be constructed by us will be ready early in the fall. Pursuing the same methods as have made our gas business so great a success, it will be our aim to give the best service at most reasonable rates. We therefore request all users of electricity who intend to make a change in their supply to communicate with the undersigned, stating the average amount of electricity used by them, and the price paid. It is the intention of the undersigned in the beginning to construct conduits and lines where the demand is greatest and gradually cover the entire city. We advise you, in your interest, not to make any long-time contracts with other companies, until you have conferred with our representatives.

San Francisco.—Fire destroyed the Rio Vista Light & Power plant at Rio Vista a few days ago, causing a loss of $10,000.

Los Angeles.—Huntington Park citizens will hold a mass meeting to decide on an issue of $15,000 bonds for the construction and equipment of an electric lighting plant.

Los Angeles.—Property owners and business men on Fourth street, from Main to Hill, have presented a petition to the Council for street lighting, which was referred to the Board of Public Works.

Lakeport, Cal.—The Board of Trustees at its next meeting will take up the matter of selling a franchise to the Lake County Electric Light and Power Company.

ENGINEERING.

Applegate, Ore.—Bids will be received by Geo. Hoffman, secretary of the Thompson Creek Irrigating association, until Feb. 1st, for the construction of a ditch from the O'Brien to Sturgin Fork of Applegate.

Echo, Ore.—The 70-ton steam shovel and four narrow gauge engines which will be used in the construction of the reservoir at the big dam on the Umatilla project and which are being moved from Hermiston to the dam site five miles distant, are now within a mile of their destination.

Great Falls, Mont.—The first unit of the Sun river irrigation project will soon be advertised and it is expected that bids will be taken about March 1st.

Lewiston, Ida.—The Waha-Lewiston Land & Irrigation Company will place surveyors in the field at once.

Proser, Wn.—One of the largest mortgages ever given was filed for record by the Benton County Abstract & Title company. It is given by the Hanford Irrigation & Power Company to the Washington Trust Company of Seattle and is for $300,000. It covers 40,000 acres of land, which will be irrigated by a pumping plant being put in at Priest rapids and also the electric power plant of the company.

Portland.—The legislature will be called upon to appropriate $50,000 for co-operation with the government in topograph mapping the state.

TRANSPORTATION.

San Francisco.—An agreement has been reached between the promoters of the Central California Traction Company and the projectors of the new electric line to connect Sacramento and Lake Tahoe, whereby the latter company will have the use of the former's tracks from Brighton to Sacramento, including the terminal of the traction concern, which will be reached by a private right of way. The Tahoe road will follow the banks of the American River from Folsom to Brighton, where it will connect with the traction company's line running from Stockton through Lodi, Elk Grove and Florin. As each of the companies is expected to maintain an hourly service, the combination of interest will mean two cars every hour from Sacramento to Brighton.

Los Angeles.—Sealed bids will be received by the county clerk for a franchise for an electric railroad upon certain public highways in Los Angeles county up to Feb. 11th. Each bid must be accompanied by a certified check of the full amount of bid. Railroad will commence at the intersection of E. Orange Grove Ave., with the easterly boundary of Pasadena, running along East Orange Grove to Allen Avenue.

Los Angeles.—Sealed bids will be received by the county clerk for a franchise for railroad to run on certain public highways in Los Angeles county up to 2 p. m. of Feb. 11th. Railroad will commence at intersection of Eagle Rock Avenue with northerly boundary of Los Angeles running along Eagle Rock to Anandale View Terrace Tract.

Los Angeles.—Sealed bids will be received by the city clerk for a franchise for a double track or four tracks of electric railroad in Los Angeles up to Feb. 11th. Railroad to run on Vermont Avenue, Trolo, Jasmine, King streets, Harvard Boulevard, Western Avenue, Manhattan Place, St. Andrews Place, Gramercy Place, GaGrnier Place adn Wilton Place.

Los Angeles.—Orders have been issued by H. E. Huntington officials to begin work at once on the line to be constructed on Seventh street.

Placentia.—Mr. Pillsbury, manager for H. E. Huntington, assures the residents that an electric road will be built through Placentia south as soon as the road from La Habra west is completed.

Los Angeles.—In Glendale several properties have been bonded to secure right of way for the Los Angeles electric line, that is to run from Pasadena and Eagle Rock Valley to Santa Monica. This line is to pass through Glendale, Ivanhoe and Hollywood, and probably touch the new town of Beverly and thence on to the Ocean Front.

WATERWORKS.

San Francisco.—The building of a reservoir near the drive in Golden Gate Park between Strawberry Hill and the ocean, was taken up at a meeting of the Park Commission this week and favorably discussed, but definite action was postponed pending an investigation as to whether the expenditure would be justified. Superintendent McLaren reported that the proposed reservoir would cost $9,513.

San Francisco.—The Mokelumne River and Blue Lakes project of water supply for San Francisco has been offered to the Supervisors by the Sierra Nevada Water & Power Company, through its attorney, John S. Partridge, for $3,000,000. The offer includes the entire rights and plant of the company. Last fall the company offered the property for $5,000,000.

San Bernardino.—The Arrowhead Reservoir and Power Company's incline in Waterman Canyon, lifting the canyon to the Skyland cliff, is to be operated by electricity immediately. The power is to be obtained from the Edison Company, which already has a power line in Waterman Canyon as far as the old Waterman barn, where the line bends to the Arrowhead Hotel. From the former point the Arrowhead Reservoir and Power Company will take it and carry the line up to the foot of the incline, which is at the head of the canyon, just across from the foot of the switchback grade. Deeds for the power line that have been filed do not include the right of way for a trolley line, but it is believed that such is contemplated, and will be taken up with property owners. The tunnel project calls for 335 feet in length 7x8 in size.

San Francisco.—The Stanislaus Electric Power Company, through its working company, The Union Construction Company, has just closed a contract for an electric power transmission scheme of importance to California industries. The site of the proposed plant is at Vallecito, on the Stanislaus River near Angels Camp and the scheme contemplates the utilization of the waters of Stanislaus River, transmitting the power electrically to San Francisco, and incidentally tapping the southern mines and the upper San Joaquin Valley. From a hydraulic standpoint the proposition is of particular interest, as it involves the largest power units that have ever been used for impulse wheels. The operating head is 1400 feet, equivalent to a pressure of 608 pounds per square inch. The present equipment calls for three 6700 kilowatt 400 revolutions per minute. General Electric generators, each of which will be driven by a Pelton water-wheel unit of 12,000 horsepower capacity. Not only are the individual units larger than heretofore attempted, but the capacity of the station in excess of 36,000 horsepower is greater than any existing at the present time. The only instance approaching this in impulse water-wheel practice is the plant of the Puget Sound Power Company, at Electron, Wash., in which are installed four Pelton wheel units, each driving a 3250 kilowatt generator with a combined maximum capacity for the station of 30,000 horsepower. The units for the Stanislaus plant will be of the "double over-hung" construction, characteristic of Pelton design for high power wheels, each overhanging the opposite end of a heavy shaft which carries the motor of the generator in the center. The equipment will represent the highest development in hydro-electric transmission, and the installation is looked forward to with the greatest interest by engineers generally.

Dawson, Y. T.—The preliminary survey for the power line of the Fuller Grant line between Coal Creek and this place is being run by Garrett Tyrell and party. The company plans to install its large power plant at Coal Creek next year.

OIL.

Bakersfield.—The Recruit Oil Company, which is another name for the Associated, and which is holding thousands of acres of supposed oil land in the Elkhorn Valley, had 50 men on its claims on January 1st to prevent any "jumping." These claims, embracing a large part of the valley, for the most part, had no assessment work done on them, and were consequently subject to relocation, hence the men to protect the company's interest. The Union Oil Company also had a force of men in the same locality, it and the Recruit having pretty much the whole territory located. On these lands there is no mineral in evidence unless it be gypsum here and there, and it is reported that a government agent has recently visited the west side country investigating the claim of gypsum discovery, upon which so much land is held.

San Francisco.—The Union Oil Company is preparing to put in larger boilers and to enlarge its pumping plant at Norwalk.

Phoenix, Ariz.—The sandstone rocks northeast of this place have been found to carry paraffine oil and test wells will be bored. The field is eight miles from here, and higher than the city, so that pumping to the two railroads would be easy.

San Francisco.—The capital stock of the Bull's Head Oil Works has been increased from $1,000,000 to $5,000,000, that is from 10,000 shares of stock, par value, to 50,000 shares.

ELECTRIC RAILWAYS.

Sacramento, Cal.—There has been filed in the office of the county recorder a deed by W. H. Basler and wife to the Northern Realty Company of the 18 12-100 acre tract of land on the east bank of the American River, near to 19th Street if extended. This means that the long and bitter litigation between Mr. Basler and the Northern Electric Company over the condemnation of the tract is at an end. On the 9th of November, 1906, the jury gave a verdict for Basler for $7,000; with this he was dissatisfied, claiming that $12,000 or $13,000 would only be fair compensation. No sooner was the verdict entered than Basler moved to suspend the entry of judgment on the ground that the Northern Electric Company is not a California corporation and that under its Nevada charter it has not the power to build and operate railroads in this State, and hence not the right to call upon the courts to exercise the power of eminent domain in its behalf. Now comes the deed of Basler to the Northern Realty Company, which closes the whole business involved. Under the terms of settlement Basler receives $8,000 cash and reserves the right to remove from the tract all the timber and the fencing.

San Francisco, Cal.—The Board of Supervisors has passed to print an ordinance granting to the United Railroads a franchise for the construction and operation of an overhead trolley system on Sixteenth Street, from Kansas to Seventh. The corporation named was the only bidder for the franchise, which is to run for 25 years, and in its bid agreed to comply with the charter requirements on franchises, which include the payment to the city of a fixed percentage of the gross receipts of the road. The road will tap the new w sale district near the Potrero and the sale of the franchi as petitioned for by many wholesale merchants and lab men. It is understood that work on the road will begin a e, the Western Pacific Company having agreed to withdraw injunction proceedings as it will not interfere with the proposed tracks on Sixteenth Street, for which it has petitioned for permits, to connect with its main line. The judiciary committee was given one week's time to report on the petition of the Presidio and Ferries Railway Company for an extension of 90 days' time to complete the work of converting the Union street cable road into an electric system.

Chico, Cal.—The Northern Electric Company has made application before the Board of Supervisors for two franchises in the county. One application is for a franchise to construct a spur freight line around the eastern limits of Chico. The other petition asks for a route west from the intersection of Oak and Fifth Streets on the west side of the tract. This is for the line from Chico to Hamilton City. The city 1,600 feet to where the route enters the Northgraves petitions ask for a 50-year franchise, for single or double tracks and the right to haul both passengers and freight traffic with steam, electricity or compressed air motive power.

San Francisco, Cal.—The Northern Electric Company has ordered 200 flat cars from the East, and part of them are en route now. They will be used between Chico, Oroville, Marysville and Sacramento. Their capacity is 80,000 pounds, and they are of modern type.

Columbia City, Wash.—The Seattle, Renton & Southern has applied for a franchise extending from its line on Rainier Boulevard up Ferdinand to Noble, from Noble to Holmes and from Holmes back to the boulevard. The Seattle Electric Co. has applied for franchise to lay tracks down 37th Ave. to America St. This is the extension of the Rainier Heights line.

Davenport, Wash.—The county commissioners renewed the franchise of the Big Ben Transit Co. from this place to Crystal City, on the Spokane River.

Portland, Ore.—At the meeting of the East Side Business Men's Club a movement was started to get the Portland Railway, Light & Power Co. to provide suitable waiting rooms for passengers at the principal transfer points on the East Side.

Spokane, Wash.—The Inland Empire has announced that it will extend its line from Waverly to Pullman and Moscow, thence south to Lewiston, Ida.

Seattle, Wash.—Councilman Crichton has called a mass meeting of the citizens of Queen Anne Hill to take up the matter of car line extension on top of the hill.

Tacoma, Wash.—The Tacoma Ry. & Power Co. is erecting passenger stations at various points on the line between South Tacoma and the terminus. Construction work is also in progress upon the big loop at the end of the line.

Boise, Ida.—During the present year the Short Line will construct a line from Armsted on the Utah Northern to the Gilmore section in Lemhi county, a distance of 70 miles.

Cheyenne, Wyo.—It is reported that the Burlington has awarded contract to Guthrie Bros. for the construction of a road through the Twelve-Mile Canyon. Estimated cost, $1,000,000 a mile.

Juneau, Alaska—The Perseverence Mining Co. will immediately commence the construction of a narrow-gauge railroad from this place to Silver Bow Basin.

Kiona, Wash.—J. S. Washtock, a sub-contractor on the North Coast Ry., has established a camp north of town.

Kiona, Wash.—Seventeen N. P. surveyors under W. D. Clegg arrived here to make a new survey to straighten the track on each side of this place.

Missoula, Mont.—Winston Bros., the contractors in charge of the N. P. construction work in Western Montana, will build those stretches of the Milwaukee road extending from Durant to Garrison, a distance of 36 miles, and from this place to Saltese, a distance of 100 miles. Winston Bros. will sub-let nearly all the work.

Lewiston, Ida.—Naylor & Norlin, of this city, who have a contract on the Milwaukee road, are establishing a camp in Douglass county on Beaver creek.

Pendleton, Ore.—The Pacific Coast Construction Co. has completed one-third of the grading for the Pilot Rock Ry. which is being extended from this place to Pilot Rock.

Portland, Ore.—It is reported that contracts have been let for the Nation-Klamath Falls line of the Southern Pacific.

Seattle, Wash.—One of the most elaborate systems of railway terminals on the Coast has just been announced by the Union Pacific. They include switching and terminal tracks, dump yard, round house, machine shops, repair shops, and turntables. They will be located in Seattle, Georgetown and along the line of the interurban tracks, embracing ground 6,000 feet long and 700 feet wide, with a capacity of 4,472 40-foot freight cars, in addition to the buildings that will be erected on the grounds.

TRANSMISSION.

Kingman, Ariz.—Superintendent Porter of the Gold Road M. & E. Company, has left for Los Angeles, where he will confer with the directors of his company regarding the installation of a power plant at Kingman. The power will be transmitted to Gold Road and the machinery of the big mill hoisters and outside power will be electric. The capacity of the mill will be increased.

San Francisco.—Samuel L. Napthaly, chief engineer of maintenance and operation of the San Francisco Coke and Gas Company, is to sever his connections with the corporation, to accept a position with the Fleischhacker interests. On the 1st of March Mr. Napthaly will resign the position he has held for many years to become manager of the Truckee River General Electric Company and the American River Electric Company, both interests being controlled by the Fleischhackers.